ELECTRICAL REVIEW

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VIEWS, NEWS AND INTERVIEWS.

A director of the Western Union Telegraph Company states that the company will not pay any extra dividend, but that before the end of another year the dividend payments will be increased to the rate of six per cent. per annum.

New York's 400 is interested in a suit brought by Miss Dresser against the Edison Illuminating Company, of Newport, R. I. On August 18, 1890, Mrs. Cornelius Vanderbilt gave the ball of the season, the house and grounds being lighted by electricity from a plant specially built for the occasion and set up by the Edison Illuminating Company. In returning from the ball at 1.30 o'clock on the morning of August 19, Miss Dresser was thrown from her carriage, the horses taking fright as they passed the engine in temporary use upon the grounds. The horses ran, the carriage was upset and the occupants were thrown out. During the last Summer it has often been remarked that Miss Dresser was somewhat lame, and now, it is said, that she has never recovered from the accident, the effects becoming more serious as time passes. Last week papers were served on Mr. John Whipple, the treasurer of the Edison Illuminating Company, in a suit for $50,000. The action is brought in the United States Circuit Court, and the writ is made returnable on November 16.

There is talk in Lynn of the Thomson-Houston Electric Company having to build more factories the coming Summer, to make room for their rapidly increasing business.

It is said that the cause of James Gordon Bennett's recent return to America is his desire to accompany John W. Mackay to Puget Sound to arrange for a commercial cable to China.

The rumor is revived that President Henry M. Whitney, of the West End Street Railway Company, of Boston, is about to retire. Those who have intimate knowledge of the inside affairs of that great corporation discredit the report.

Until recently the royal palace at Berlin has been lighted only by candles. Both the father and the grandfather of the present Kaiser were opposed to gas and would not allow it to be introduced into the palace. Emperor William has had gas put in and is now arranging for electric lights.

Chief Barrett, of the electrical department of the World's Fair, is confronted by what appears a unique predicament. He states that owing to the many and rapid improvements being made in electrical machines most manufacturers are afraid to prepare an exhibit until the last minute. By the time the fair opens, two years hence, the fixtures they now have in hand may be, according to Chief Barrett, the most antiquated of "chestnuts."

When the Thomson Electric Welding Company was organized it purchased from Professor Thomson five patents and five applications. To-day the company has 131 patents and applications, besides several which it has in foreign countries.

Drawbaugh Defeated.

Commissioner Simonds, of the Patent Office, on October 25, rendered a decision on an appeal from a decision of the Board of Examiners-in-Chief denying patentability to the subject matter of an application for patent for telephones, filed by Daniel Drawbaugh April 3, 1884, the same being in continuance of his original application, filed July 26, 1880, on the ground that the invention in controversy was put into public use and on sale by Thomas A. Edison and others for more than two years prior to July 26, 1880, the date of the filing of the original application.

This application has been pending in the Patent Office for more than 11 years. After an exhaustive review of the whole case the Commissioner finds "that the improvement in controversy was in public use and on sale for more than two years prior to the time when Drawbaugh filed his application for patent under consideration, and that for such reason he is not entitled to a patent therefor, and the decision of the Examiners-in-Chief is affirmed." This application also stands rejected for another reason, stated in a decision of the Board of Examiners-in-Chief, dated February 26, 1890. This decision is affirmed by the Commissioner *pro forma*.

The Rae Motor.

One of the most striking of the working exhibits at the Pittsburgh Convention was the Rae motor, as manufactured by the Detroit Electrical Works. It was shipped to Pittsburgh merely mounted on a McGuire steel truck, and was only temporarily attached to a 16-foot Brill body. The car went into special excursion service on one of the leading electric railways of the city, on which some very heavy and long grades were encountered. No trouble whatever was found in running up the grades at a steady speed of eight miles per hour. The truck was fitted with a single 40 horse-power Rae standard motor geared to both car axles. The performance of this car was the subject of a great deal of notice, and many very favorable comments were made by the practical men present. Those who were unable to get time to ride on this car examined with interest a $500 model Rae motor and truck at the hotel.

A Model Mining Plant at the Frankfort Electrical Exposition.

The number of persons visiting the model mining plant, shown in Fig. 1, daily is between 1,000 and 2,000, which shows the interest taken in this exhibit. The fare to go through the mine is 20 pfennig or about five cents. The locomotive has a 10 horse-power motor mounted upon its trucks and the car will carry 20 persons each trip. The "Gruben bahn" or underground railway runs under the grotto shown in the same view. After making a run of about 200 metres, the passengers alight and walk into the various underground passages where they see the most modern mining apparatus in operation. The most of the apparatus shown in this exhibit is manufactured by Siemens & Halske, Berlin. The passageways and tunnel for tramcars are lighted by electric mining lamps, and in numerous little chambers may be seen the strata or layers, and seams in the natural metal ores, such as lead, zinc, copper and iron, together with the apparatus used for that special class of mining. Coal mining, however, is not exhibited at any great length.

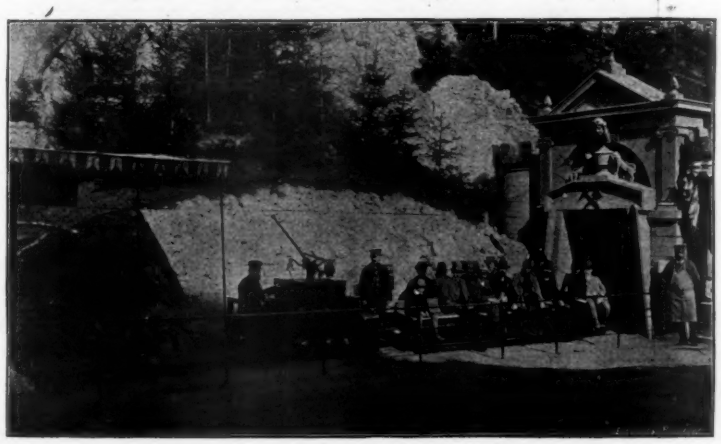


FIG. 1.—MODEL MINING PLANT AT THE FRANKFORT ELECTRICAL EXPOSITION.—FROM A PHOTOGRAPH BY OUR SPECIAL CORRESPONDENT.

The electrical drilling machine of Siemens & Halske may be seen in Fig. 2. It is constructed to be worked with continuous or alternating currents and the power consumed is one electrical horse-power.

An electric running pump, also shown in Fig. 2, is in operation and is run by continuous current at a potential of 150 volts. The power consumed is from three to four horse-power. The pumps deliver 1,000 litres of water per minute at 10 or 15 metres. The mine is ventilated by an electric ventilator, using about five horse-power.

A serious accident happened at this mine a few days ago which resulted in the death of one of the guards. On account of having an inexperienced engineer in handling the locomotive, the current was turned on with greater intensity, instead of being turned off as was desired, and the locomotive ran into the post at the end of the line outside, and in knocking it over it struck one of the guards, seriously injuring him. He died within a few hours. However, the cars have been crowded since, in spite of the accident. P.

Frankfort, October 14, 1891.

Behring Strait Telegraphic Scheme.

In these days, when the cables between America and Europe are in such constant use, most people have forgotten a great enterprise for securing telegraphic communication with Europe by way of Behring Strait and Siberia. Cyrus Field had just made an attempt to lay another cable across the Atlantic with the "Great Eastern," but the cable had snapped in mid-ocean. Many capitalists, believing that Field's idea could never be realized, formed a company to extend a telegraph line from San Francisco up the coast to Behring Strait, run a cable across to Siberia, and then connect with the telegraphic systems of the old world. A large construction fleet began work on Puget Sound, with the steamer "George S. Wright" as flagship. The "Fremont," "Milton," "Badger," "Palmetto," "Nightingale," "Jennie Pitto," "Egmont" and others, brought up supplies from San Francisco. R. R. Haines, the superintendent of construction, had a big force of men, organized and uniformed like an army. The line from San Francisco to New Westminster, in British Columbia, was owned by the California State Telegraph Company, and beyond that it was known as the Collins Overland and Western Union Extension. The line followed the east shore of the Sound to New Westminster, and some of the original poles can yet be seen sticking in the mud. The work was carried 800 miles north of New Westminster to Skeena, when the complete success of the Atlantic cable suddenly put a stop to construction. The army of men was mustered out, and the materials that could be recovered were taken away. Thousands of tons of wire and material distributed along the line through the woods of British Columbia remain there to this day. Several years afterward a party of woodsmen took to Port Townsend a cargo of the wire and offered it for sale, but the creditors of the company seized it immediately. The Seabeck mill sawed out thousands of the poles for the line, which were piled up on the mill wharf and lay there until burned with the mill a few years ago. The captain of the ship "Egmont," which lay in Esquimalt with a cargo of submarine cable, got drunk and ran off with the ship's papers. The vessel lay in the harbor for two years, unable to clear. Her owners finally patched up Hawaiian papers for her and she sailed away.

George H. Mumford, afterward vice-president of the Western Union, came out here in 1872 and wound up the affairs of the company, paying every bill in full. The American end of the line was absorbed by the Western Union, and the extension to Skeena was operated for a few years and then abandoned. H. L.

Seattle, Wash., October 20.

The first number of the nineteenth volume of *St. Nicholas* contains the beginning of a serial for boys, by Brander Matthews. It is called "Tom Paulding," and deals with the search by a New York boy for buried treasure in the upper part of Manhattan Island. Local color is given in the first chapter by the bright flames of an election night fire. This is Mr. Matthew's first venture in writing a long story for the young.

Interesting Street Railway Display.

EXHIBITS, ELECTRICAL AND OTHERWISE, AT THE TENTH ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION, AT PITTSBURGH.

The exhibition boat floating in the river just below the Monongahela House had its lower deck completely filled with the exhibits of attending manufacturers and supply men. Besides the exhibits here there were a large number in the hotel and several cars were shown on a platform built on the river bank. The showing made by the manufacturers and supply men was indicative of considerable progress during the year and was creditable in the extreme.

The steamer "Mayflower" was moored a short distance below the exhibition barge, and contained a number of exhibits of railway supplies and materials.

A large number of exhibits were shown at the Monongahela House.

John White, of Allegheny, Pa., had an exhibit of insulators, pull-offs, etc.

The Street Railway Journal was handsomely ensconced in Parlors 1 and 2.

Mr. Van Nuis Ajax carried a "Fulmen" lightning arrester on his watch chain.

The Partridge Carbon Company, of Sandusky, O., made a fine display of carbons.

The McConway & Torley Company, of Pittsburgh, made an exhibit of rail joints. Messrs. C. McLaughlin and J. J. Ghegan, of J. H. Bunnell & Company, New York, were present.

Post & Company, Cincinnati, had a fine exhibit of street railway specialties in charge of Mr. I. Kensey.

The Bodifield Belting Company, of Cleveland, Ohio, exhibited several rolls of belting of various sizes.

The Pittsburgh Steel Hollow Ware Company made an exhibit of pedal gongs of silver steel.

The Lewis & Fowler Girder Rail Company, of Brooklyn, made a display of a new style of girder rail.

President Maybin W. Brown ably represented the Eastern Electric Supply Company, of Boston.

Mr. Daniels represented the Mitchell-Brant Copper Company, of Erie, Pa., who exhibited fine copper products.

The Reliance Guage Company, of Cleveland, made an exhibit of safety water columns and other steam appliances.

The Western Electric Company, of Chicago, had a very attractive exhibit of their electric railway appliances and supplies.

Morris W. Meade, superintendent of the Pittsburgh bureau of electricity, extended numerous favors to the electrical visitors.

The Press Club of Pittsburgh became quite a rendezvous for the electrical visitors, and a warm welcome was extended to all.

The Brownlee Car Company, of St. Louis, exhibited on a platform alongside the hotel one of its handsome new "accelerator" cars.

The Lewis & Fowler Manufacturing Company, of Brooklyn, exhibited one of their new snow sweepers for electric railways.

The Engineering and Equipment Company, of New York and Boston, showed a collection of the Anderson insulators and line materials.

The Boston Trolley Company had a large number of pole hangers, clips, tree insulators, feed wire insulators, pull-offs, etc., on exhibition.

The Burton Electric Company, of Richmond, Va., occupied part of Parlor 5 with a display of their well known electric heaters for street cars.

The Mitchell-Brant Copper Company, of Erie, Pa., made an exhibit of commutator segments adapted to the various makes of motors and generators.

The Westinghouse Electric and Manufacturing Company extended a cordial invitation to all the visiting street railway men to inspect their factories.

The United States Graphite Company, of Saginaw, Mich., exhibited their Sonora graphite lubricant. Mr. W. G. Wilmot was present for the company.

Charles H. Davis, of New York, presented the electric railway men with a little circular containing facts and figures of special interest to them.

The Stearns Manufacturing Company, of Erie, Pa., distributed printed matter regarding the Woodbury automatic engines and the boilers made by this company.

The headquarters of the ELECTRICAL REVIEW were in Room 53 of the Monongahela House. Charles W. Price and Stephen L. Coles represented the paper.

The Eastern Electrical Supply Company, of Boston, made a large display of electric railway specialties, which included a complete line of overhead appliances.

The Calorific Ventilating Heater Company did some unique advertising during the convention, one, especially, being in the form of calorific blanks and envelopes.

The Lieb Machine Works, of New York, displayed a complete line of street railway supplies and appliances in the harbor master's office, near the Smithfield street bridge.

The Electric Construction and Supply Company, of New York, lighted the exhibition barge with eight or nine Ward arc lamps operated from the street railway circuit.

The Forest City Electric Works occupied a part of the harbor-master's office with a handsome switchboard showing their various well known power station appliances.

The Electrical Supply Company, of Chicago, made a very complete exhibit of street railway appliances in their parlor. They also furnished the delegates with a handsome badge.

Prof. William A. Anthony, of the Mather Electric Company, attended the convention. The street railway men were all glad to meet this prominent scientist and electrician.

The Tripp Manufacturing Company, of Boston, exhibited their roller bearing for car axles, a trolley with roller bearing attachment, and their well known piston packing.

The J. G. Brill Company had a 25 foot double truck car on the platform. The car equipped with a Short gearless motor running on the streets of Pittsburgh was also a Brill car.

Messrs. Nuttall, Mayer and Manning represented the R. B. Nuttall Company, of Allegheny, Pa. Their exhibit comprised steel pinions, rawhide gears and other street railway specialties.

The Revere Rubber Company, of Boston, had an exhibit of their flexible conducting "Flexite," a substitute for hard rubber. The company was represented by Messrs. Ellicott and Chaney.

The John Stephenson Company, of New York, distributed a handsomely bound morocco memorandum book. On the inside cover was a resumé of the car building business of the company.

The Standard Underground Cable Company, of Pittsburgh, made a large display of their cables. The exhibit included lead and tape-covered cables and wire, and other well known productions of this company.

The Bridgeport Brass Company had an exhibit of several reels of wire on the "Mayflower." One reel was of bare hard drawn copper wire, and another of insulated feeder wire. Mr. H. D. Stanley was present for this company.

The Peckham Motor Truck and Wheel Company, of Kingston, N. Y., had an exhibit in the Westinghouse parlor of a model of their well known truck. One of the full size trucks was shown on the landing stage near the hotel.

The Robinson Machine Company, of Bellwood, Pa., exhibited a Robinson electric motor truck. The truck is built of steel, has a wheel base of six feet, and is equipped with 30 inch wheels, weighing complete 8,000 pounds.

M. J. Sullivan gave out a neat pocket memorandum book, with the compliments of the Edison General Electric Company. It contained a few facts and figures for street railway managers of special interest and importance.

The Electric Merchandise Company, of Chicago, occupied Parlor 5 with an exhibit of street railway supplies. There were also shown rawhide pinions, steel wire track brooms, electric head lights for cars and insulators in many patterns.

Payson K. Andrews, Phœnix building, Chicago, who represents the J. G. Brill Company, of Philadelphia, met many friends in street railway circles and carried off the honors for being one of the handsomest men of the convention.

The National Fare Receiver Company, of Nashville, Tenn., exhibited their novel fare receiver attached to a man, by whom it was operated. Mr. J. E. Allison, the general manager of the company, made many friends by his urbane manners.

The Detroit Electrical Works had in operation, on the Duquesne Track Company's line, one of the handsomest cars ever shown. It was fitted with one of their 40 horse-power standard equipments, and was inspected by a large number of the visitors.

The Gould & Watson Company, of Boston and Chicago, had a very complete exhibit of moulded mica insulators and line

FIG. 2.—ELECTRIC DRILL AND PUMP IN MODEL MINING PLANT AT FRANKFORT ELECTRICAL EXPOSITION.—FROM PHOTOGRAPH TAKEN BY OUR SPECIAL CORRESPONDENT. (See first page.)

construction devices. Voltmeters and ammeters by the Whitney Electrical Company, of Boston, were also shown in this exhibit.

The Charles Munson Belting Company, of Chicago, exhibited samples of their belts for electric railway power stations. A special 48 inch belt finished for the Pittsburgh and Birmingham Traction Company, was also shown. Col. J. H. Shay represented this company.

The Baltimore Car Wheel Company, of Baltimore, Md., exhibited a motor truck of a new design. The wheels were 36 inches in diameter, the springs spirals, and the boxes oil and dust tight. The brakes were operated by a powerful crank movement.

The Jewell Belting Company, of Hartford, Conn., had an exhibit, consisting of a 48 inch double belt, 110 feet long, and weighing 1,800 pounds, made for the Toledo Electric Street Railway Company. There was also shown a photograph of the company's factory.

An artistic little book, consisting of four pages and cover, in which mention was made of their wires, cables and cordage, was presented by Mr. P. C. Ackerman, of the American Electrical Works. This little pamphlet was in itself a work of art, size 3½x2½ inches.

The Falls Rivet and Machine Company was represented by President E. L. Babcock and Secretary H. J. Stambaugh. The friction pulleys manufactured by this company are giving the highest satisfaction wherever used, and in electric lighting and power circles are being quite generally adopted.

The Rochester Car Wheel Works made an exhibit of their wheels, ranging in size from 22 up to 36 inches in diameter. A Barr contracting chill used by this company in the manufacture of these wheels was also shown. Very neat card counters, formed of cuts of two of their car wheels, were distributed.

The Edison General Electric Company occupied a parlor on the first floor, where a power station switchboard, completely equipped, and Edison motors on a track were shown. The room was handsomely fitted up with tasteful electroliers, and an entertainment was provided by the company every evening.

The J. G. Brill Company, of Philadelphia, exhibited in a parlor on the first floor one of their newest trucks. The truck has an extended spring base supported by truss rods, and is designed for carrying long cars over rough tracks. A large number of these trucks have been sold, and orders are in hand for many more.

The Wightman Electric Manufacturing Company, of Scranton, Pa., displayed a truck with two 20 horse-power Wightman S. R. G. motors. There was also shown a controlling stand and trolley. The truck used was of the DuPont type, manufactured by Dorner & Dutton, of Cleveland, Ohio. Inventor Wightman was present.

The street railway companies of the city of Pittsburgh presented to the delegates a handsomely bound volume of 25 pages, containing a large number of illustrations, showing points of interest about Pittsburgh. A book of complimentary tickets, good for passage on any of the street lines of the city, was also presented to each delegate.

A party of wideawake young men, who represented the allied Westinghouse interests, extended many kindnesses to the visitors. Their names were: C. A. Bragg, L. B. Stillwell, E. W. Seymore, A. T. Taylor and Alexander Moffitt. Mr. Stillwell is one of the progressive young electricians of the day, and is doing notable work for his company.

The Short Electric Railway Company exhibited a car equipped with two of their new gearless motors operating on the street car tracks of the city. Very neat passes were issued to all who wished to ride, and this privilege was taken advantage of by large numbers. The Short company also had a handsome parlor in the Monongahela House, where tasteful literary matter was distributed.

The Solar Carbon and Manufacturing Company, of Pittsburgh, occupied one end of the barge with a very complete and well arranged exhibit of their various carbons. Motor brushes for street railway and other uses were shown in great variety. A very large carbon, 48 inches long, by 6½ inches in diameter, was shown. The company also distributed little medallions made of hard carbon, carrying their advertisement.

Mr. George Westinghouse was met by a number of the visiting delegates at the Westinghouse factory, where a very interesting exhibit of the single reduction and gearless motors of the Westinghouse make was quite a point of interest. Not only the factory of the electric company, but also the immense engine works, where a 500 horse-power engine was just being completed for an electric lighting company at St. Louis, were visited.

The Thomson-Houston Electric Company tendered a reception to their friends on Tuesday evening. Their headquarters were crowded. A large number of the members of the Pittsburgh Press Club were present. A part of the company's exhibit occupied a prominent position on the exhibition barge. This included a handsome switchboard for street railway power stations, a 15 horse-power S. R. G. motor, a 15 horse-power D. R. G. motor and a 15 horse-power D. R. G. motor designed for use on narrow gauge lines. A number of other devices were also shown.

The Westinghouse Electric and Manufacturing Company had a very complete exhibit on the barge, showing their various types of motors. A feature of interest was a 25 horse-power S. R. G. motor in a watertight covering immersed in a tank of water and operating as if it were on dry land. There was also a 15 horse-power D. R. G. motor mounted on a stand, and a Gilbert truck fitted with two No. 4 gearless motors, with controlling stands, rheostats and connections. Besides these there was a McGuire truck equipped with two 25 horse-power S. R. G., four-pole motors.

A neat idea was that of having the business cards of the representatives of the Short Company engraved and bound between leather covers by brass rings. On the exhibition boat a Short gearless motor was in operation, as well as the standard and the S. R. G. types. A Short generator was run by a Short motor, current for which was furnished by a street railway circuit running over the bridge nearby. There was also shown a display of fittings for overhead construction—controlling stand, rheostats and a

very handsome switchboard equipped with the company's different types of instruments.

The Oil Well Company, of Pittsburgh, kept open their exhibition in the Exposition building at Pittsburgh, and through the courtesy of Mr. George C. Dickson and Mr. J. C. Bruff the interesting exhibit was visited by a great number of delegates. This company, in connection with Eaton, Cole & Burnham, manufactures a number of specialties used with steam, gas and water.

Major H. C. Evans, the very popular and widely-known representative of the Johnson Company, Johnstown, Pa., was everywhere at once, meeting friends at every turn. In street railway circles no man is more popular or more widely acquainted, and a convention without his presence would be a clear case of Hamlet without the presence of the mournful Dane.

Among the list of electrical gentlemen present were: Jarvis B. Edson, of the Edson Recording Gauge Co., N. Y.; W. B. Cleveland, of the Cleveland Switch Co., inventor of the Cleveland switch, Geneva, Ohio; F. A. M. Burrell, of Charles A. Schieren & Co., N. Y.; Charles L. Pullman, of the Pullman Palace Car Co., Chicago; Charles E. Chapin, of Alexander, Barney & Chapin, N. Y.; Dan. Hungerford, of Benedict & Burnham, Waterbury; Eugene Wallace, of Wallace & Sons, Ansonia; General Manager Warfield, C. A. Benton and J. E. Lockwood, of the Detroit Electrical Works; Col. L. R. Greene, of the Walworth Manufacturing Co., Boston; P. C. Ackerman, of the American Electrical Works; George L. Wiley and Fred. Degenhardt, of the Standard Underground Cable Co.; Col. J. H. Shay, of the Munson Belting Co.; George H. Roe, San Francisco; W. J. Hammer, N. Y.; Frank J. Sprague, N. Y.; Capt. Eugene Griffin, of the Thomson-Houston Electric Co., Boston; J. P. McQuaide, of the National Conduit Co.; J. M. Orford, of the Union Electric Manufacturing Co., Bridgeport; C. L. Tolles, of the Jewell Belting Co.; W. L. Candee and T. McCoubray, of the Okonite Co., N. Y.; R. B. Corey, of the Electric Construction and Supply Co., N. Y.; Theo. P. Bailey, of the Thomson-Houston Co., Chicago; S. S. Leonard, of the Hill Clutch Works, Cleveland.

The Edison General Electric Company was represented by the following gentlemen: A. D. Page, assistant manager, lamp manufacturing department, Harrison, N. J.; Charles D. Shain, district manager, eastern district, Edison building, New York; John I. Beggs, manager, central district, Chicago, Ill.; F. R. Chinnock, special agent, Edison building, New York; John Muir, general manager, contracting department, New York; W. S. Andrews, technical assistant, Schenectady, N. Y.; S. Dana Greene, general manager, sales department, Edison building, New York; M. J. Sullivan, intelligence department, New York; John W. Lieb, Milan, Italy; George W. Mosby, New York; James A. Brett, engineering department, New York; H. Wray Weller, New York; I. H. Silverman, Pittsburgh, Pa.; F. Mansfield, railway department, New York; Chas. Hewett, New York; Ed. L. Draffen, New York; Frank J. Sprague, consulting engineer; William F. Brewster, special agent, Chicago, Ill.; Geo. W. Sillsby, Washington, D. C.; W. G. Whitmore, eastern district engineer, New York; W. J. MacConnell, supply department, Pittsburgh, Pa.; W. G. Bushnell, New Haven, Conn.; J. W. Schroeder, Pittsburgh, Pa.; C. C. Adams, Pittsburgh, Pa.; J. C. Bennett, New York; C. C. Pierce, special agent, New England district, Boston, Mass.; William S. Elliott, Chicago, Ill.; F. G. Fuller, cable and wire department; New York; Frank Gillett, fixture department, Pittsburgh, Pa.; Julius S. Weyl, Pittsburgh, Pa.; M. Lamb, Pittsburgh, Pa.; Geo. Breed, Pittsburgh, Pa.

The Empire State Express.

The New York Central and Hudson River Railroad have recently put in service the "Empire State Express," which is said to be the fastest regular train in the world. The route covered is from the Grand Central Station in New York city to Niagara Falls. This flyer leaves New York at 9 A. M., arrives at Buffalo at 5.40 P. M., and reaches Niagara Falls at 7.20 P. M. There is no extra fare charged for passage on this train, which weighs 481,800 pounds and consists of a locomotive, a combination buffet smoking car, two standard New York Central coaches, and a Wagner buffet drawing-room car. Luncheon, wine and cigars are served on board. Passengers on the "Empire State Express" can breakfast in New York and dine at Buffalo or Niagara Falls.

Eugene, Ore.—Crouch-Houston Electric and Manufacturing Company, Frank J. Crouch, president; to manufacture dynamos under the Crouch patents; capital, $1,000,000.

A New "Ward" Arc Lamp Catalogue.

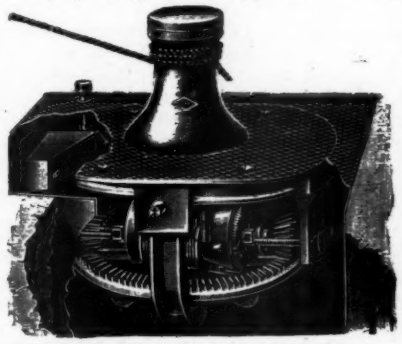
The Electric Construction and Supply Company, 18 Cortlandt street, New York, have issued a very tasteful catalogue describing the various types of "Ward" arc lamps. The cover carries a striking drawing of a beautiful lady sitting on clouds and illumining herself and the clouds with a "Ward" lamp which she holds suspended in her hand. The lamp is connected in series with the clouds.

The illustrations and diagrams are printed in red and black inks, and the letter press in black. A number of very strong testimonials as to the merits of the "Ward" lamps complete the book.

General Manager Corey is to be congratulated upon this handsome production, which is the work of Bartlett & Company, New York.

Electric Capstan.

The electric capstan shown in the accompanying cut is used by the Compagnie du Chemin de Fer du Nord, Gare du Nord, Paris. It is suitable for use in railway stations and termini where electrical power is available from accumulators charged during the day by the regular lighting plant.



WOODHOUSE & RAWSON'S ELECTRIC CAPSTAN.

This capstan is able to furnish a force effort of 400 to 500 kilogrammes with a linear speed of .6 of a metre per second at the periphery of the head or body of the capstan; the diameter of this head is .4 of a metre. The linear speed corresponds to 70 revolutions per minute. The speed of the head of the capstan is capable of being reduced, in case of need, to 12 revolutions per minute to turn locomotives upon a turntable. This reduction of speed is effected by a simple modification in the coupling of the electrical parts, and by a lowering of the voltage from 200 to 100 volts. The motive power of the machine, which must be at least, 25 amperes without deterioration, is supplied by lead accumulators of 25 kilogrammes. The actual horse-power obtained is about eight, while 12 is the maximum passed into the dynamo. The machine was built by Woodhouse & Rawson (Limited), of London, England.

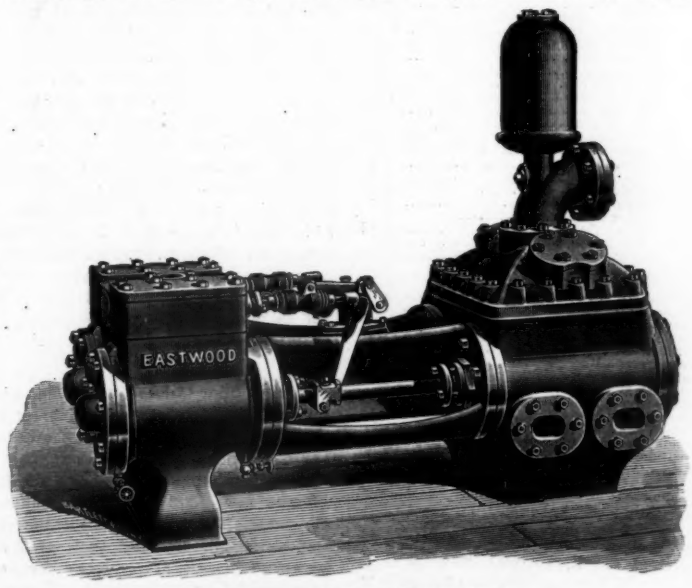
The Eastwood Duplex Steam Pump.

The duplex steam pump which we illustrate herewith, was designed and patented by M. M. Moore, manager for Benjamin Eastwood, at No. 114 Liberty street, New York. It consists of two double acting steam pumps placed side by side, the steam valve of one pump being operated by the motion or travel of the other. By this action we get the result of two single pumps operating together, and are enabled to simplify the steam valve to the common slide or D valve.

As either steam valve receives its motion by the travel of the piston of the other pump, it is necessary that the steam valve should remain stationary during a part of the stroke, while the valve stem continues its allotted travel. To accomplish this result a certain amount of lost motion is allowed on the valve stem which operates the steam valve only for a part of its travel. This amount of lost motion and the travel of the valve stem regulates the length of stroke of the pump. It is customary to have this regulation in the steam chest, which makes it very disagreeable to get at when adjustment is required and the pump is allowed to run at short stroke rather than break the joints and correct the adjustment.

To obviate this trouble was the aim of the inventor, which is accomplished by a very simple method. The valve stem is a straight piece of steel; one end connects to the steam valve and extends through the packing gland to a bearing or guide which is attached to the rock shaft bracket. On these valve stems are attached two collars between which travels a sliding sleeve operated by the crank of the rock shaft, this rock shaft being operated by the long arm attached to the piston rod. Thus is motion caused directly from the piston rods to the steam valves.

In each end of the sliding sleeves on the valve stem is a threaded bushing which can be screwed out or in to adjust the amount of lost motion that may be required to secure the full length of stroke at all times and under all conditions. This adjustment can even be made when the pump is in motion. The valve stems, sleeves, links, cranks, arms and shafts are duplicated, one side with the other.



THE EASTWOOD DUPLEX STEAM PUMP.

In the smaller sizes the regular plunger pattern is used, and the larger sizes are fitted piston pattern. But by the use of an improved removable water cylinder any size can be quickly changed from plunger to a removable water cylinder with adjustable piston packing. The piston pattern is best for heavy lifts of suction.

These duplex steam pumps of all sizes and for all purposes are now being manufactured by Benjamin Eastwood, of Paterson, N. J. Mr. Moore, manager of the New York office, is a gentleman of great experience in steam pump matters.

Portland, Me.—Electro Novelty Company; capital, $50,000.

Roselle, N. J.—Union County Electric Light Company; capital, $30,000.

Brooklyn, N. Y.—McLeod Electric Manufacturing Company; capital, $3,000.

Jersey City, N. J.—The Mott Visual Telegraph Company; capital, $500,000.

Elizabeth, N. J.—The American Mutual Telephone Company; capital, $500,000.

Plainfield, N. J.—American Nautical Telephone Company; capital, $500,000.

Waterloo, Ia.—Bates & Blake Electric Railway Conduit Company; capital, $1,000,000.

Zanesville, O.—The Merchants' and Manufacturers' Telegraph Cable Company; capital, $10,000.

Gloucester, N. J.—Heisler Electric Company, to manufacture electric apparatus; capital, $250,000.

Taylorville, Ill.—Christian County Electric Railway Company, W. W. Anderson, president; capital, $1,000,000.

Monmouth, Ill.—The Monmouth Motor Street Railway Company has increased its capital from $30,000 to $60,000.

Middletown, O.—Middletown and Madison Street Railroad Company, J. W. Lanehardt, president, has increased its capital from $10,000 to $50,000.

Elmhurst, Ill.—Elmhurst Electric Light and Power Company; capital, $15,000. Incorporators, W. H. Emery, Warren Buchner, W. E. Hagens and F. H. Bates.

Atlantic City, N. J.—Atlantic Electric Light and Power Company; capital, $50,000. Promoters, C. L. Cole, C. J. Adams and C. E. Brown, all of Atlantic City.

Elyria, O.—The Lake Erie Electric Light Company; capital, $20,000. Promoters, F. M. Townsend, H. W. Worst, Sam Rawson, C. E. Wilson, W. L. Fay and Lester McLean.

Springfield, O.—The Springfield Light and Power Company; capital, $200,000. Promoters, Allston Burr, C. H. Pierce, John H. Miller, W. A. Scott and George Martin.

Wampa, Idaho.—The Wampa Electric Light and Power Company; capital, $24,000. Promotors, J. N. Jones, P. W. Purdue, of Wampa, and H. E. Simmons, of Summit, N. J.

Pittsburgh, Pa.—The McKeesport Fuel and Light Company, of Pittsburgh; capital, $10,000. Directors, R. C. McLean, H. Sellers McKee, J. G. Ormsby and J. D. McCabe, of Pittsburgh, and Wm. D. Hartupee, of Charlerol.

Columbus, O.—The Columbus and Westerville Railway Company, to operate a street railway by electric or other power; capital, $100,000. Promoters, M. H. Neil, Lewis Huffman, Adam G. Innis, George W. Williams, G. W. Meeker, F. H. Houghton, J. W. Everal, E. H. Reasener and C. E. Bell.

The Chicago, St. Louis and Kansas City Railway, of which Mr. W. R. Busenbark is the well-known traffic manager, headquarters at Chicago, was the first road to bring out a railway folder advertising the World's Fair. On one side of the folder is the usual time-tables, maps, etc., and upon the reverse appear illustrations of the World's Fair buildings, and a map of that portion of this hemisphere covered by this enterprising railway company.

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Mr. Merwin J. Bulkley will hereafter represent the ELECTRICAL REVIEW in the West with headquarters at Chicago. We bespeak for Mr. Bulkley the courtesy and consideration which our Western friends have extended in the past to our representatives.

At a meeting of the committee on electricity, electrical and pneumatic appliances, of the World's Columbian Exposition, held October 26, the following names were decided upon as those of eminent electricians not now living, to be placed over the electricity building at the Exposition, namely: Franklin, Galvani, Ampere, Faraday, Ohm, Sturgeon, Morse, Siemens, Davy, Volta, Henry, Oersted, Coulomb, Ronald, Page, Weber, Gilbert, Davenport, Soemmering, Don Silva, Arago, Daniell, Jacobi, Wheatstone, Gauss, Vail, Bain, De la Rive, Joule, Saussure, Cooke, Varley, Steinnell, Guericke, La Place, Channing, Priestley, Maxwell, Coxe, Thales, Cavendish.

There is a gradual but substantial improvement in all industrial branches of business and the electrical field is, as usual, in the lead in this respect.

What an impressive array of electrical and mechanical apparatus was exhibited at the Pittsburgh Street Railway Convention! One seeing it could not fail to realize the great ingenuity and wideawakeness of the American inventor.

An engineer at Chemnitz says he has constructed the smallest working engine in the world. The machine fits into an ordinary nutshell, and is of sufficient power to drive a cotton reel. The inventor proposes to exhibit his work at the Chicago fair.

Major Moses P. Handy, the alert head of the Bureau of Publicity and Promotion of the World's Columbian Exposition, is proving to be the right man in the right place. His work is being done quietly and efficiently and the press of the country is beginning to realize it.

Next Fall an international exhibition is to be held at Kimberly, South Africa. Steamship companies will offer passage at reduced rates. The Cape Colony Railroad will carry people from Cape Town to Kimberly for $15, though the regular fare is $90. It is desired that the exhibit of mining machinery be made as complete as possible. Here is another opportunity to exploit electric mining apparatus.

Mr. John A. Sleicher, formerly editor of *Frank Leslie's Illustrated Weekly*, has assumed editorial charge of the *Mail and Express*, a leading afternoon journal of this city. Mr. Sleicher is one of those young men from the country who is not afraid of long hours and hard work, and this important element, with his acknowledged capacity and experience, are sure to bring him success and honor in metropolitan journalism.

According to Mr. R. G. Dyrenforth, in the *North American Review*, not only can we make it rain by creating explosions in the air, but "it also seems probable that the immense amount of frictional electricity generated by the concussions and the mingling of opposing currents of air may have considerable influence in the formation of storm centers by producing a polarized condition of the earth and air, and so creating a magnetic field which may assist in gathering and so condensing the moisture of the surrounding atmosphere." Shade of Franklin! What jargon is this? Is watery vapor magnetic? Perhaps, after all then, animal magnetism is not merely a figure of speech, and a lingering Romeo and Juliet kiss not so much a matter of sentiment as of magnetic grip.

Advices from Chicago, under date of October 30, inform us that the chief of construction of the World's Fair has ordered the contractors, who are constructing the World's Fair buildings, to double the force of men now employed on the buildings. The chief of construction made the order imperative, and said that they would have to work two shifts of men eight hours each or make 16 hours a day's work. The necessity of haste has been apparent for some time to a number of World's Fair officials. Several weeks ago Exposition officers visited the grounds and discovered that on the electricity building, over 700 feet long and nearly 300 feet wide, there were but 47 men employed. On the manufactures building, which is 1,500 feet long and 700 feet wide, not more than twice that number of men were at work. Throughout the grounds a similar ratio of workmen to the size of the building prevailed. The buildings actively under way and on which visible progress has been made are the mines and mining, electricity, manufactures, administration, woman's, horticultural and transportation.

ELECTRICITY AS A REFORMER.

If the reported efficiency of the Gülcher thermal battery, at Frankfort, is correct, this type of generator will meet a keenly felt want for isolated electric installations. That phase of electrical application which relates to its domestic use is only in the first stage of its growth. The central station system of supply will answer fully for towns where many users warrant the erection and maintenance of a large plant, but in suburban districts electric motors and electric lights are, by the methods of generation now practiced, inattainable. The expensive, troublesome and clumsy primary batteries are simply not in it, as the universal and costly experience of that progressive portion of the public which has lent an ear to the persuasive primary battery fiend fully demonstrates; even in experimental work where it is under the direct supervision of operators competent to handle it for all it is worth, it is an annoying instrument. With some efficient apparatus which simply requires the lighting of a gas flame or the kindling of a fire, however, a warm reception is assured not only for experimental work in country districts, but for purely domestic uses. A convenient and regulable motor will soon grow to be a real necessity to every household. The farmer can churn, and thresh, and saw wood, pump water, grind tools, and perform with dispatch and convenience numerous other duties which constitute the drudgery of farm life. He can light his house with incandescent lamps and thus maintain in his country home a degree of luxury now only attainable in city life. The economic advantages of such a generator would thus be far-reaching; it matters not what the relative economy of the thermal battery is to the dynamo so long as it does its work well and will last, so that when a plant is once installed there will be a reasonable certainty that the only item of maintenance will be fuel. It is claimed for the Gülcher battery that two kilogrammes of coke per hour will give a current of 80 volts and 10 amperes and suffice for feeding eight 16-candle incandescent lamps continuously. A ton of coke would maintain four lamps in continuous use on the same scale of expense for four hours every day for 125 days. During the day the energy could be used to do the chores. Electric light and power ought thus to come within the reach of all. One of the chief points claimed for the battery is its long life. The couples consist of a positive element of an antimony alloy and a negative element of nickel. The field of use for some such generator is very wide, and its adoption would be far-reaching in consequences. Country life would be invested with a charm, and the tendency of the race to aggregate in cities and towns would be materially mitigated. The real secret of the multifarious *isms* under which the poor are contrasting their lots with those of the rich is a spirit of discontent created by the hardships incident to life and employment of unskilled labor in cities. There is plenty of land in this country to maintain in ease and comfort all of our people, but farm life has no charm for young men; the return is small for a large amount of hard work, and the household is destitute of the conveniences possible with a small income in a city. Electricity can do much to change this feeling if it can be generated where wanted by a somewhat heavier draught on the woodpile—the fire must be maintained at all events. The same device which warms the dwelling or cooks the food can be made to furnish power and light, and will be cheerfully consecrated to such a duty. True, the coal or wood supply will dwindle more rapidly, but that would prove a matter of insignificant importance compared with the comforts supplied. Whether the type of generator mentioned will prove equal to such emergencies remains to be seen, but some form will undoubtedly be found to meet the want, and then electricity, which has so largely contributed to the comfort and happiness of mankind, will enter the ranks of social reformers.

Mr. Kennelly's able paper on "Magnetic Reluctance," read before the American Institute of Electrical Engineers last week, is an interesting essay on a very important subject. Mr. Kennelly's prefatory remarks form a *resumé* of the various magnetic theories which have come down to us.

CORRESPONDENCE.

OUR CHICAGO LETTER.

Mr. J. R. Burdick, representing H. W. Johns Manufacturing Company, of New York city, made us a call while in the city this week on business.

The Illinois Electric Material Company, of this city, report a big call for the Ries regulating socket lately put upon the market. The demand has been so great for this socket that they find it difficult to fill orders.

Personal.—D. B. Dean, with Electric Merchandise Company, returned to the city to-day. Mr. Dean visited several eastern cities after attending the Pittsburgh Convention and returns with some very nice orders.

General Counsel Grinnell, of the Chicago City Railway Company, announces that his company will soon put in a fuel oil plant at its power house. The State and Twentieth street power house has been smoking vigorously, and suit has been entered against the company in consequence for violating the smoke ordinance. The West Division Street Railway Company is burning oil with great success, and the Illinois street power house on the north side will soon use oil instead of coal as fuel.

The Strawger Automatic Telephone Exchange was incorporated to-day by the inventor A. B. Strawger, his brother W. S. Strawger of Kansas City, M. A. Meyer and Joseph Harris, of Room 301, Rookery building. The object is to iessen the time consumed in connecting telephones and to do it without the aid of a central office. It consists of a simple looking board 2½x5 inches and located upon the battery box. Five keys are upon this with thousands, hundreds, tens and units marked thereon. A person desiring to connect with number 1,457 pushes the thousand key once, the hundred key four times, the ten key five times, and the one key seven times. The numbers of the telephones are so placed that the pressing of the keys connect them together, and the aid of an operator is unnecessary. M. J. B.

Chicago, October 31.

OUR BOSTON LETTER.

Mr. John H. Noble, of the Stanley Electric Manufacturing Company, Pittsfield, Mass., was in Boston this week.

Mr. George F. Porter, general agent of the Washington Carbon Company, Washington, Pa., is visiting this section on business.

Mr. Albert H. Mills, of the Steele & Johnson Manufacturing Company, Waterbury, Conn., was among the recent callers on the electric firms of this city.

The New Haven Insulated Wire Company, New Haven, Conn., has established a branch office at No. 18 Cortlandt street, New York. Mr. H. G. Madden has been appointed agent in charge.

The West End Railway Company, this city, announces that "on and after Thursday, October 29, all cars now running on Tremont street by horse power will be operated by electricity."

Another Electrical Enterprise will soon be established at Lowell, Mass. It is authentically stated that before long there will be organized a new company in the city named to manufacture electrical goods.

The Electro Novelty Company, capital stock, $50,000, has been organized at Portland, Me., for the purpose of manufacturing electrical and mechanical novelties. J. P. Cushing, of Boston, Mass., is president, and E. C. Russell, of Natik, Mass., treasurer.

Messrs. Albert and J. M. Anderson, this city, the widely-known manufacturers of electrical specialties for street railways operated by electricity, have equipped, it is said, every electric car on the West End Street Railway, Boston, with their patent tapered steel trolley pole.

The Westboro, Mass., and Marlboro Street Railway, having cars operated by horse power in the town first named, will soon be extended to and through Marlboro and thence to Hudson, Mass. Electric propulsion will supersede horses on the cars now in use, and all the new cars will be equipped with Thomson-Houston electric motors.

Boston, October 31. W. I. B.

High Pressure Electrical Distribution.

Under the above heading our esteemed London namesake, *Electrical Review*, presents the following pertinent suggestions:

A writer reviewing the progress made in the art of electrical distribution by high pressure alternating currents and transformers, and looking to the results achieved in and around London, especially at Deptford, concludes that long distance transmission by these means is, commercially, a "dreary failure." Various reasons are given for supporting this conclusion; principally these are based on the loss of power alleged to occur in transforming the pressures first *up* to 10,000 volts at Deptford and then twice *down* to the consumers in London, and also to the great expenditure of capital which has been found necessary, having an eye to a large supply in the future, while neglecting the more pressing needs of the present demands. Such criticisms are, perhaps, premature. The Deptford installation has been planned and carried out in every detail under very exceptional circumstances. There was absolutely no experience to draw upon in constructing and installing plant for the generation and distribution of alternating currents at 10,000 volts pressure, and the scheme altogether was planned on a very gigantic scale, so that the expenditure of time and money has been necessarily on the same scale.

The questions to be decided by the results of the working of the Deptford installation are most likely to be as to whether 10,000 volts is too high a pressure for practical use; whether the saving in copper in the mains is not far more than overbalanced by the increased cost of insulation throughout the plant. There must be a pressure at which we can work, where the saving in copper is such that it makes it worth while to work with alternating currents at high pressure. At that pressure the insulation cost must not be much higher than that for ordinary three-wire 200 volt working.

High pressure saves the copper in the mains only, but it *adds* to the cost of insulation all over—in dynamos, mains and transformers.

Another question is whether the generators should be of the large sizes proposed, or should be divided into numerous small units. At Deptford very large dynamos are to be used, if the scheme is carried out in its entirety. Most practical engineers incline to the use of small units, independent of each other, a practice universally carried out in American generating stations. It would seem from the fact that the 10,000 volts sent from the Deptford station is got up by a transformer, that large dynamos present difficulties in the way of generating such a high pressure directly. This system, using low pressure alternators and transforming up to high pressure, is one which has many advantages at other places as well as at Deptford. At generating stations in cities or towns the low pressure alternating currents can be distributed directly from the dynamos all around the immediate vicinity of the station without transformation, while for distant consumers it can be passed through a transformer transforming up to any voltage.

There can be little doubt of the wisdom of placing a large generating station outside of a large town altogether. Land is less costly, coal, as a rule, much cheaper, and the coal, it must be borne in mind, is the raw material out of which the article to be sold is manufactured at a generating station, especially if carried to the door by water, and condensing water, if got for nothing, is also a consideration. Where engines of thousands of horse-power are to be run these savings would certainly repay the extra outlay on a few miles of mains. A large generating station in a city has some objectionable features—smoke, steam, dirt and noise; coals for thousands of horse-power, water for same, and the removal of ashes, have all to be considered in fixing upon a site for a large generating station. These points seem to have been thought over in fixing the plant at Deptford. The ultimate triumph of the alternating current distribution depends chiefly on its flexibility, and on its being rendered available for power and storage; with these and its easy transformation it must succeed.

Time must elapse yet before any decided conclusions in this direction can be drawn from the working of the Deptford scheme.

Meanwhile improvements are constantly being made by many inventors in nearly every detail; these all tend to the perfection of the art. Many of them cheapen the first cost of the plant and effect economies in distribution, so that it would seem bad policy on the part of electrical supply companies to go in on a large scale for future contingencies; with sufficient plant for present needs these improvements can be secured in any additional plant required as the consumers increase in numbers.

In the near future the incandescent lamp will be made and sold by many firms and much cheapened in price; the electric light business will receive an enormous impetus, and then large stations like Deptford may show up the possibilities in the way of generation and distribution at very high pressures.

The high pressure transmission between Lauffen and Frankfort at 20,000 volts is quite another problem solved, not a distribution over a town or city. It only proves the perfection to which insulation on pole lines of wire can be brought up to. Neither does the perfection of the polyphasal alternating motors mean much increase of consumers on the presently existing alternating current generating stations, where, as a rule, only one current of one phase is supplied.

He Knew His Business.

[From the Washington *Star.*]

Managing Editor—Do you think that new man has had any experience in a newspaper office?

City Editor—Yes, indeed.

Managing Editor—What makes you think so?

City Editor—The first thing he did when I gave him a desk was to hide the ink and lock his pen up.

Carborundum, a New Abrasive Material.

A competitor of bort or diamond dust as a polishing material is now on the market under the name of "carborundum." The material is of a beautiful crystaline structure, the octahedron formation predominating. The crystals are transparent, and in color are white, blue, yellow, green and black. It is not affected by any reagent, and remains permanent at high temperatures. In hardness it is 10 on Mohr's scale, being equal to the diamond. The material has been highly indorsed by lapidaries and diamond polishers as cutting as well as powdered diamonds, and has been used to polish diamonds and sapphires with entire satisfaction. The material is manufactured by the Carborundum Company, of Monongahela City, Pa.

World's Fair Department of Electricity.

TO THE EDITOR OF ELECTRICAL REVIEW:

Several of the largest manufacturers of Europe and America have recently made inquiries as to the possibility of their securing the necessary space for very large exhibits. Among these applicants are one from Europe and one from an American firm, each asking for 50,000 square feet of space in the electricity building. It is certain that if all of the larger manufacturers of the world demand space in proportion to the size of their business, there will not be room for all exhibits.

A number of European firms are making preparations for large exhibits, but as yet their applications for space have not been received.

Mr. Keller has received several communications regarding historical apparatus, and it begins to look as though this exhibit would be a credit to the department.

Yours respectfully,

J. P. BARRETT, Chief.

The seismic instruments at the observatory in Berlin indicated the tremor of the Japanese earthquake between 11 P. M. and midnight on Monday, October 26.

The street railway men of the United States deserve the highest commendation for the prompt manner in which they have taken up electricity. Any one attending the Pittsburgh convention must have been impressed with the earnestness and enterprise in this direction of the successful representatives of corporate interests.

In view of the present development of electric traction, there is something almost humorous in the following cablegram:

LONDON, October 27.—At Leeds, on Thursday next, will be thrown open to the public the first electric tramway to be operated in England by the overhead wire system. A trial of the new tramway was had yesterday and it proved a success. A car, containing 22 passengers, was taken over the line, after which an experiment with several cars coupled together was made. The system is that of the Thomson-Houston Electric Company, of Boston, Mass. The power is carried from a central station over wires strung on tall posts.

A number of eminent newspaper workers of the East expect to visit San Francisco January next in a special train which will cross the continent from the East in great style. The occasion is the annual meeting of the International League of Press Clubs, and it is expected that these eastern moulders of public opinion and other things will learn much of value and importance concerning the Far West. As a special attraction, Hon. M. H. DeYoung, of the San Francisco *Chronicle*, has promised a first-class California earthquake in addition to the "glorious climate."

Phenix Telegraphic Club.

At the October meeting of the Phenix Telegraphic Club, held recently at the residence of Mr. M. Leggett, 281 Adelphi street, Brooklyn, the following officers were re-elected: A. Timmermann, president; George Erbelding, vice-president; W. D. Shumway, treasurer; Frank H. Briggs, superintendent, and John P. Holder, electrician. The resignation of S. W. Conner as secretary being accepted, Frank L. Catlin was elected to that office for the ensuing year.

New York Electric Club.

Thursday night of last week was "Wurzburger Nacht" at the Electric Club. Gambrinus was king and Nicotina queen of the festival. Their sceptres were "churchwardens" and "Old Rip" furnished the incense. It was a night of relaxation from electrical and scientific matters.

Vocal music was furnished by the Gilbert Quartette, Mr. Caldwell, of the "Miss Helyett" Company, and Mr. Prime, of the St. George's Church choir. Messrs. Geo. H. Guy, F. R. Colvin and Franck Z. Maguire, performed upon the piano. Mr. Harry M. Peckham furnished the professional humor, while Mr. George B. Muldaur, who parades as an amateur, recited some funny Irish things in the best brogue ever heard in the club.

Mr. T. C. Martin, chairman of the entertainment committee, acted as starter and announcer. The events were called by German names and Mr. Martin's Hoboken accent was much admired.

The large number of members and their friends who were present, feel better acquainted than they did before "Wurzburger Nacht."

American Institute of Electrical Engineers.

A meeting of the Institute Committee on the International Electrical Congress of 1893 was held in the office of the secretary, 12 West Thirty-first street, New York city, October 27. The committee is composed of the following members:

Edward Weston, Dr. S. S. Wheeler, Geo. A. Hamilton, Prof. Henry Morton, Prof. Chas. R. Cross, C. H. Haskins, R. W. Pope, Prof. W. A. Anthony, F. L. Pope, Prof. E. J. Houston, T. C. Martin, T. D. Lockwood, C. H. Phelps, C. O. Mailloux and Carl Hering.

The committee organized permanently, and elected T. C. Martin chairman and R. W. Pope secretary. It was voted that the members of the existing Committee on Units and Standards be added to the Congress Committee, also the following members: Prof. Elihu Thomson, Prof. Alexander Graham Bell, Dr. E. L. Nichols, Mr. Nikola Tesla and Mr. Ludwig Gutmann. A subcommittee of three was appointed by the chair, composed of Messrs. Carl Hering, W. A. Anthony and A. E. Kennelly, to formulate a provisional programme for the work of the Congress. The chairman is a member *ex officio* of this committee.

It was recommended that the council appoint a committee to be sent to Chicago as soon as possible to represent the claims of the Institute to a leading part in the Congress and to arrange for its co-operation with the authorities there upon a proper basis. The council subsequently appointed Prof. Elihu Thomson, Mr. C. H. Haskins and Mr. F. L. Pope as such committee.

At the meeting of council the following associate members were elected: Capt. Achilles de Khotinsky, Boston; Robert Edward Dunston, Plantsville, Conn.; Edward T. Middleton, New Brunswick, N. J.; Joseph T. Monell, New York city; T. Carpenter Smith, Philadelphia, Pa.; Frederick G. Strong, Denver, Colo.

At the meeting of the Institute in the evening Vice-President Lockwood presided. After the reading of a paper on "Magnetic Reluctance," by Mr. Kennelly, which was very freely discussed, the report of the Committee on Units and Standards was taken up, and, after considerable discussion, it was decided to take no definite action at present. Professor Ryan communicated some corrections in his paper read at the September meeting, but on account of the lateness of the hour its further discussion was postponed.

Telephonic News

*** Tucson, Ariz., is to have a telephone exchange.

*** The Greenwich and Johnsonville, N. Y., Railway has decided to run a telephone line to Johnsonville on the line of its road.

*** Woodruff, S. C., will very soon be connected by telephone with Spartanburg, as the wires for that purpose are now being put up.

*** The New England Telephone and Telegraph Company has declared a dividend of 75 cents per share, payable November 14 to stockholders of record October 31. Books close November 1 to November 13, inclusive.

*** The New England Telephone and Telegraph Company is to build a new storage building on Farnsworth street, Dorchester, Mass. It will be constructed of brick and measure 140x100 feet. Part of the structure will be three and the rest two stories in height with a high basement.

*** A proposal has been made by Dr. Strecker, of Berlin, which seems to solve the question of telephone charges. He proposes to levy a fundamental charge to meet the expenses for installation, maintenance and depreciation, in addition to a time charge, to meet the working expenses. Nothing could be fairer than to charge for the use of the telephone according to the duration of conversation, and Dr. Strecker proposes to use a clock which goes as long as the conversation lasts.

WORLD'S FAIR NOTES.

J. Allen Hornsby, secretary of the department of electricity, who was sent to Frankfort-on-the-Main to study the electrical exposition there, has made a report, which shows that out of compliment to the Columbian Exposition the Frankfort Exposition was kept open a fortnight longer than was originally intended, in order to give Mr. Hornsby a chance for thorough investigation. Secretary Hornsby writes that there is electrical apparatus on exhibition at Frankfort which, when put in operation, will cause the eyes of American electricians to open in wonderment.

All of the restaurants in the mines and mining and electricity buildings will be in the galleries. This was determined in order to leave the ground floor free as far as may be for intending exhibitors. It is thought also that restaurants on the second floors of the buildings would prove an attractive feature. It was also decided that the restaurants in the electricity building be located in the two bays at the north end of the hall. In each bay there is to be one large dining room, surrounded by several smaller rooms 23 feet square. The balcony connecting the two is to be fitted up for serving temperance drinks and ices. In the great manufactures building about 40,000 square feet have been set apart for restaurants.

A concession has been granted to M. Stepanni to erect a Moorish palace at the World's Fair. One of the many attractions which he proposes to exhibit in this palace is $1,000,000 in gold coin in one pile. He believes that this will be a great drawing card and that nearly every visitor will want to see it. Of course, great precautions will be taken for the safety of such great treasure. It will be in a strong cage, and Mr. Stepanni says: "Just under the gold will be constructed a fire and burglar proof vault. To the doors of this vault will be connected electric wires. In the event of an attempt to rob the palace, my guards will press an electric button, the entire pile will fall into the vaults and the doors will spring shut." A space 200 by 250 feet was granted for the Moorish palace, upon which Mr. Stepanni says he will expend $400,000.

Combination Adjusting Screw.

Looking at the ordinary electric bell, now so universally used, one would hardly think there is room for improvement. Perhaps not so far as the user is concerned; but the manufacturer is ever on the alert for methods that will tend to better the bell without adding to its cost.

An exceedingly clever and valuable improvement in bell manufacture, styled a new method of assembling bells, has recently been patented by Richard Varley, Jr., of Passaic, N. J., whose late inventions have attracted considerable notice.

The device consists of but three parts, which take the place of the somewhat complex mechanism now in vogue for the adjusting attachment. These parts are the rubber stopple, Fig. 2, which affords an insulator for the adjusting screw, and serves as a lock nut by compression of the rubber; the adjusting screw itself, and a connecting clamp, Fig. 3. The office of this clamp is

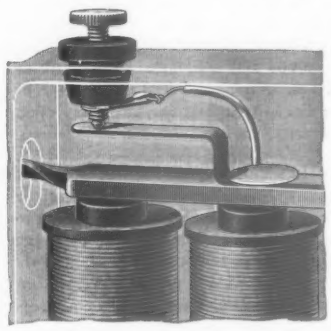


FIG. 1.—VARLEY'S COMBINATION ADJUSTING SCREW.

to connect the wire from the coils to adjusting screw, it being held in position by the two prongs that fit into the small holes shown in the rubber stopple.

The simplicity of this device may be briefly explained by stating the method of adjusting it to the bell. The stopple is first placed in position by forcing it through the hole in side of box and through upright in skeleton bell. Next the connecting clamp (which has previously been connected to the wires leading from the magnets) is placed in position by forcing the prongs into the stopple. This brings the hole through which the adjusting screw passes in alignment with the hole running through the stopple. Lastly, the adjusting screw is pushed through the rubber stopple, which forms at once a perfect insulator and a lock nut for keeping it in position.

Fig. 1 shows the device complete attached to an iron box bell. In skeleton bells a lug is cast on the frame in place of the regular binding post now in use. Through this lug is drilled a hole which admits of the rubber stopple, as in box bell described.

FIGS. 2 AND 3.—VARLEY'S COMBINATION ADJUSTING SCREW.

Aside from cheapening the materials necessary to make a bell, it greatly economizes the labor necessary for assembling the parts. It also adds to the bell's efficiency to the extent of preventing it getting out of adjustment by loosening of the screw, as the latter cannot turn in the soft rubber bed and a very prevalent source of trouble is thus avoided.

This valuable device has been placed on the market by J. Jones & Son, 602 West Twenty-second street, New York.

The Electric Mutual Insurance Company.

This company has issued a well illustrated pamphlet entitled "Specifications for inside hose system and water supply to protect electric stations against fire." One paragraph is worth money to any station manager, if the advice contained in it be followed: "Carelessness is the father and dirt the mother of fire, and concealed spaces the shelter that nourish it to life. None of these should be permitted in an electric station."

LITERARY.

We have received "Colorado College Studies," a pamphlet containing a number of papers read before the Colorado College Scientific Society.

"Transactions of the American Institute of Electrical Engineers" for August and September, form a double number containing the papers read at the annual meeting.

Decked in a new and unusually artistic Thanksgiving cover, the November *Ladies' Home Journal* comes as the first reminder that the holidays are approaching. Everything about this issue of the *Journal* seems of the best, and a higher standard has never been reached in any previous number.

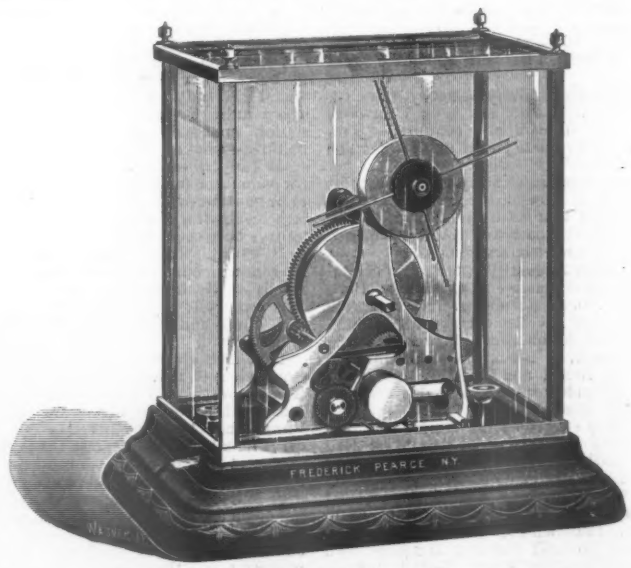
Mrs. Frances E. Lanigan, the wife of George T. Lanigan, the brilliant newspaper writer, will hereafter be Mr. Bok's chief associate in the editorial management of the *Ladies' Home Journal*. Mrs. Lanigan has been for years successfully connected with newspaper work, and she is said to be one of the cleverest women journalists in the country.

The feature of the November *Century* which is likely to attract the most attention is, probably, the new novel, "The Naulahka," by Rudyard Kipling and Wolcott Balestier, the latter a well-known American now living in London. This is Mr. Kipling's first experience in collaboration, and the story is not only international in authorship but in plot. It opens on the bridge of an irrigating ditch in a Western State, and at the close of the first instalment there is already an indication of a change of the scene to India. The motive of the story is the quest of an American, Nicholas Tarvin, for a celebrated necklace of jewels which hangs round the neck of an idol in the province of Rajputana, and which he has promised to bring back to Mrs. Mutrie, at Topaz, Colo., in order to obtain her influence in behalf of the town he is booming. In the working out of this unique theme the reader may look for some surprising situations.

Pearce's Spring Inking Register.

The improved spring inking register shown in the illustration presented herewith is manufactured by Frederick Pearce, 77–79 John street, New York. The register is made with one or two pens and, when so ordered, can be arranged for a wide or very narrow line. Either black oil or aniline ink can be used, which makes the registration very distinct. It has been found much more preferable than the embossing register, as the pen can be worked with greater rapidity. The writing is very pleasing to the eye, and it can be seen at quite a distance, which is due to the great contrast in color. When once the record is made, it cannot be removed.

Instead of the old style of glass shades, Mr. Pearce has substituted a metal nickel plated case. If a glass should break, it could be replaced at a small cost, compared with the expensive glass shade. All the electrical parts are well insulated, and the base is made of metal to prevent warping and getting out of adjustment by any change in temperature.



PEARCE'S IMPROVED SPRING INKING REGISTER.

The "Champion" Battery.

The E. S. Greeley & Company, 5 to 7 Dey street, New York, have put upon the market a battery invented by Mr. C. J. Hirlimann and called the "Champion." Prof. Henry Morton, of the Stevens Institute of Technology, has made an extended series of tests of this battery. His report is, in part, as follows:

"I have made a careful series of tests, continued during two months, with your

THE "CHAMPION" BATTERY.

'Champion' battery in comparison with the best batteries of the same type which are in general use, and as a result I find your battery to be an excellent one, equal to the best, and possessing some distinctions which in certain cases will give it an advantage.

"Thus, on open circuit or with a high resistance it shows a higher electromotive force than others, in about the proportion of 15 to 14.

"On closed circuit, through a slow resistance, however, this advantage does not appear, on account of the internal resistance of your battery, which is relatively high.

"Your battery also shows a remarkable promptness in recovering its electromotive force on the opening of the circuit. Thus, it will recover 50 per cent. of its loss in one minute, while other like batteries will only recover 10 per cent. in the same time."

Electric Welding.

The Johnson Company, of Johnstown, Pa., recently wrote the Electric Welding Syndicate, London, that they have used one of the Thomson Electric Welding Company's machines a year for general work, and the bulk of the work done by this machine was that which could not be done by hand welding, not on account of the difficulty of the weld, but because of the general unreliability of the result. The result of a year's use of the electric welder is that the company has extensively adopted the machines in its works. Within 18 months the Johnson company has purchased $46,000 worth of Thomson electric welding machines and has expended $60,000 in boilers and a plant for the machines. All contracts were for cash payment.

The Harrisburg Tandem Compound Engine.

The Ide tandem compound engine, as manufactured by the Harrisburg Foundry and Machine Works, represented in the accompanying illustrations, is substantial and compact in design, neat and attractive in appearance and is made exceptionally large in all bearings and journals with a view of comfortably transmitting the maximum power of the engine when run condensing.

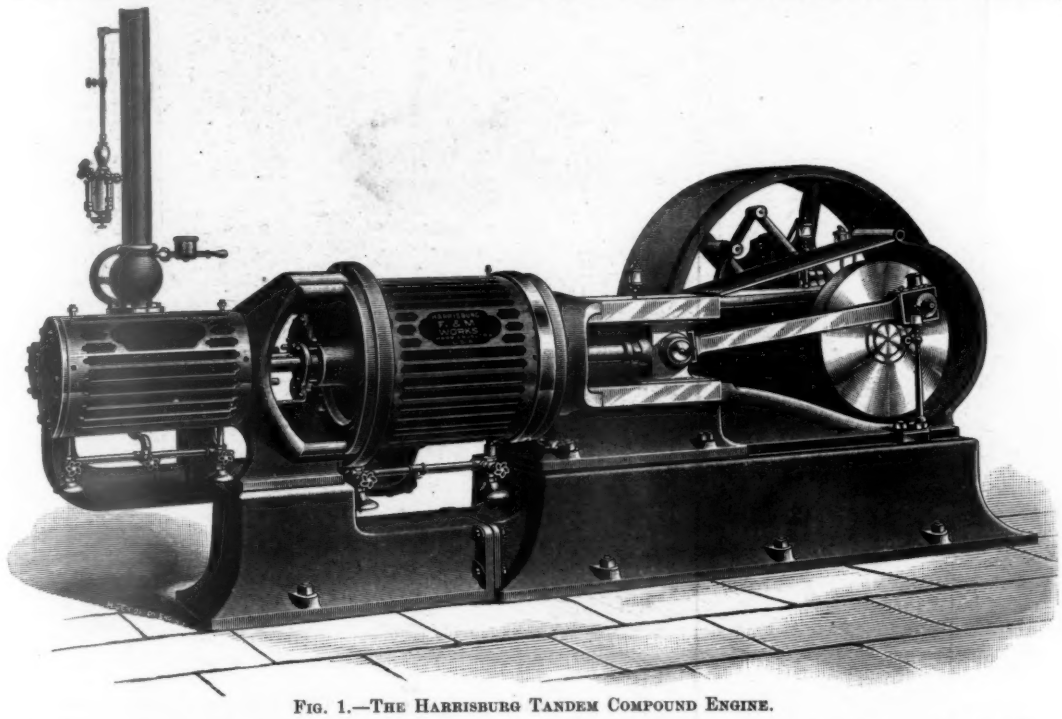


FIG. 1.—THE HARRISBURG TANDEM COMPOUND ENGINE.

It is equally well adapted for the transmission of power, whether for electric railway, lighting or factory use, being designed for working at high relative speed for direct belting if desired, with the extraordinary close regulation for which the simple Ide engine is noted.

It, however, maintains this close regulation to a great degree when running at comparatively slow speed, making the engine available for all purposes.

The advantage gained in making this connection between cylinders has been regarded so important that a patent has been applied for. The general design is clearly shown in the cut. The Harrisburg, Pa., Foundry and Machine Works are represented in New York, Boston, Philadelphia and other cities through their regular agencies.

A Point for Telegraph Patrons.

Redington & Company, wholesale druggists, of San Francisco, are engaged in a suit against the Pacific Postal Telegraph Company that may result in declaring void the conditions imposed upon patrons by the telegraph companies and which are printed on their message blanks.

Redington & Company sent a message to their attorneys in a Southern California town directing them to attach the business of a delinquent merchant for a bill of $1,908. The message, as delivered to the attorneys, read "nine hundred and three dollars," the "teen" having been omitted. An attachment was issued for the lesser amount.

When the error was discovered other merchants had levied attachments, and their prior suits took precedence over the action for $1,000 that was subsequently brought by Redington & Company, and they lost the money.

The telegraph company was called upon to make good the amount, which they refused to do on the ground that on the back of the message was the printed condition: "The company shall not be liable for mistakes or delays in the transmission or delivery, or for non-delivery of any unrepeated message, whether happening by negligence of its servants or otherwise, beyond the amount received for sending the same."

In support of their claim they called attention to the decision of the Supreme Court of California rendered in the case of Hunt *vs.* the Western Union, in 1885, wherein it was decided that the printed conditions were binding on senders of telegrams. Since then, however, a number of Supreme Court decisions in other States have decided that the conditions are invalid, and the attorney for Redington & Company hopes that he will cause the Supreme Court of California to take the same view.

Judge Wallace has just refused to grant a non-suit to the telegraph company in this case, on the ground that the conditions are not binding.

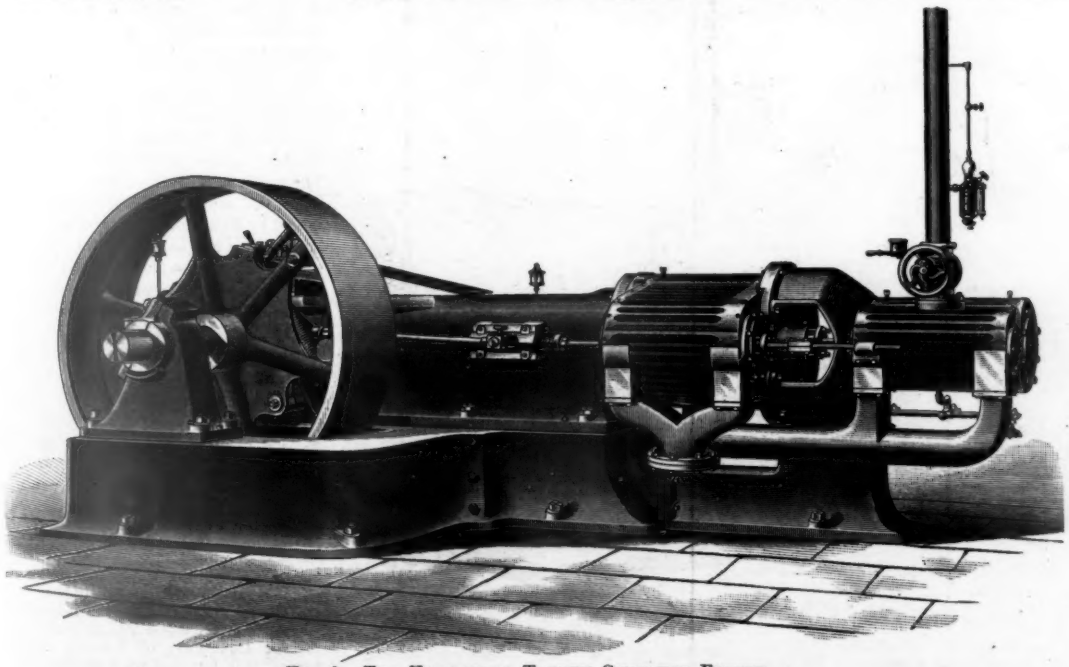


FIG. 2.—THE HARRISBURG TANDEM COMPOUND ENGINE.

When used for electric railway purposes the extra heavy shaft and fly-wheel are supported between the bearings, avoiding the overhang of the fly-wheel, as is the case in the center crank type.

One of the special features in the Harrisburg tandem compound is the method of connecting the high and low pressure cylinders. It admits of moving the low pressure cylinder head into the connections to examine the low pressure cylinder and piston without removing the high pressure cylinder or its steam and exhaust connections. The inability to do this has been one of the greatest objections to the tandem compound engines as usually built, and the advantage of the above is obvious to the most casual observer.

The manner of supporting the high pressure cylinder is more substantial than the general practice, avoiding the vibration of cylinders when working under full load.

TELEGRAPHIC

.... Natives of South Africa are employed in building a telegraph line across Mashonaland.

.... Telegraph business at Grand Rapids, Mich., has grown so much that the Western Union has found it necessary to duplex their wire between that city and Detroit.

.... A telegraph line is under construction from West Point, Ga., *via* Opelika, Lafayette, Roanoke to Gadsden, to connect at the latter place with the Postal company. The line has been completed from West Point to Opelika.

.... The Green Mountain telegraph line is now completed from Grafton to Chester and Weston. The line runs from Sunderland, by way of Manchester depot, to Londonderry, Grafton and Bellows Falls, with a Chester and Weston branch.

.... The earnings of the Western Union Telegraph Company for the third week of October, as submitted to the executive committee, are reported as being the largest but one in the history of the corporation. They were $277,234, an increase of $1,346 over 1890.

.... Back taxes to the amount of $62,669, levied upon the property of the Western Union Telegraph Company, were paid into the Massachusetts State treasury last week. The sum covers balances due for the years 1886-90, inclusive. It has taken seven years of fighting in the courts to get the money.

.... In sequestration proceedings by Lewis May, a judgment creditor to the extent of $83,580 of the North American Underground Telegraph and Electric Company, Judge O'Brien, in the New York Supreme Court last week, appointed Alvah Trowbridge receiver of the corporation, which is insolvent.

.... In the United States Supreme Court, October 26, the government moved to advance the argument of the case of The United States against the Western Union Telegraph Company. The question at issue is whether or not the government should be charged for messages presented to the Western Union, which are transmitted in part or wholly over the line of the Union Pacific Railroad, which, as a subsidized railroad, is obliged to carry telegraphic messages free for the United States.

What Electricity Is.

Prof. C. S. Page delivered his lecture on "Electricity" before a small audience at Central Music Hall last night. With the aid of electrical appliances, a galvanic battery and blackboard diagrams, he set forth his new theories. Professor Page claims that attraction is the affinity of matter for ether, and that repulsion is the meeting of currents of ether from opposite directions. He also gives ether the credit for being the fluid of life, and the nervous fluid which supplies the body. A few of his principal ideas are given in the following terms:

"Not one of the 64 elements, without the presence of ether, possesses weight.

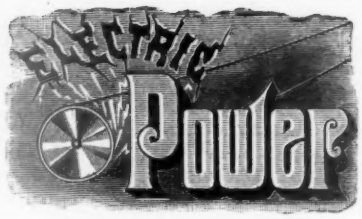
"Force is not creative, and cannot be annihilated.

"Ether is the cohesive force of nature.

"Light is the divinist subject in the universe, and the more you study it the less you know about it.

"Light is the broken particles or atoms of ether."

Professor Page gave his peculiar explanations of the thunderbolt, the dynamo, the arc and incandescent lamps, the law of gravitation, and various other obstruse matters concerning astronomy and the laws governing the universe. He was seized with a fainting fit early in his lecture, but soon recovered and was able to proceed to the end. —*Chicago Inter-Ocean.*



* * The Duquesne Traction Company last week began running cars from Pittsburgh to Wilkinsburg.

* * The Manchester ship canal is about to have an electric launch service established on it by one of the well known English companies.

* * The price paid for the street railroad in Stockton, Cal., by the company which bought it out to build an electric road was $55,000.

* * The Los Gatos, Cal., town board of trustees last week granted F. Chappelet and others a franchise to operate an electric railway through the town.

* * The Lancaster and Strasburg, Pa., Railway Company, with a capital stock of $125,000, has been chartered. The railway is to be operated by electricity.

* * The owners of the Middletown, Pa., turnpike have sold it to the new company that will run an electric road between Steelton and Middletown. The price paid was $16,500.

* * Rome, Ga., is to have an excellent electric street railway car system. The stock of the old car lines has been transferred to northern and eastern parties, who have organized with a capital stock of $100,000. Work will be started at once.

* * The Goshen, N. Y., Electric Light and Power Company has contracted with B. W. Payne & Son, of Elmira, the well known engine builders, for two 60 horsepower engines and two boilers of 125 horsepower at a pressure of 80 pounds. The company is duplicating all its machinery, thereby guarding against any possibility of accident. The dynamos will also be duplicated. Work on the building is progressing satisfactorily.

* * In the three months after the street railway company of Springfield, Mass., introduced electricity as a motive power instead of horses, the cars of the company were required to run 200,043 miles, against 184,370 for the corresponding three months of last year, and they carried 1,541,379 passengers, against 1,195,649 in the corresponding three months of last year. The operating expenses showed an increase of only about $21,000 over last year, when horses were used; while the receipts, as the results of better and more frequent service, showed such an increase as to give it an advance in net profits of more than $12,000.

The Weston Compound Engine.

The accompanying illustration shows the Weston compound engine built by the Weston Engine Company, Painted Post, N. Y., and handled in New York city by Julian Scholl & Company, 40 Cortlandt street.

As will be seen, the sub-base is made a part of the engine proper by extending it, and projecting a neck in front of the high pressure cylinder for the attachment of the large or low pressure cylinder. This arrangement has several advantages, principal among which is the accessibility of the low pressure cylinder for inspection. As leakage from this cylinder represents the most serious loss, it is obvious that the usual practice in tandem compounding, of making the low pressure cylinder practically inaccessible, is a mistake, as if no opportunity is given for examination of the piston the loss from this item may be enormous. As it is arranged in the Weston engine there is every opportunity for inspection.

Another advantage of this form is in the total elimination of cylinder vibration, indicating great rigidity and securing permanent alignment.

These engines have a balanced four admission valve on each cylinder, and both valves are attached in a direct manner without rocker arms to an automatic governor, thus keeping the load about evenly divided between the two cylinders. This has decided advantages over the usual arrangement of having a low pressure eccentric fixed to the shaft, or at best adjustable by hand, for owing to the variation of load constantly occurring in some lines of service, such as electric lighting, electric railways, rolling mills, etc., the hand adjustment is of little value as the engine must be set for the entire run before starting to the maximum load that may be thrown on during the run and as the actual load is considerably less during most of the time, the vital feature of compounding is destroyed; whereas, with the automatic attachment to each valve the engine is always in condition to take care of any load within range of its capacity, and without destroying any of the essential elements of compounding.

This feature of two automatic valves must be well received, under any circumstances, and where economy of fuel is necessary its use is most valuable.

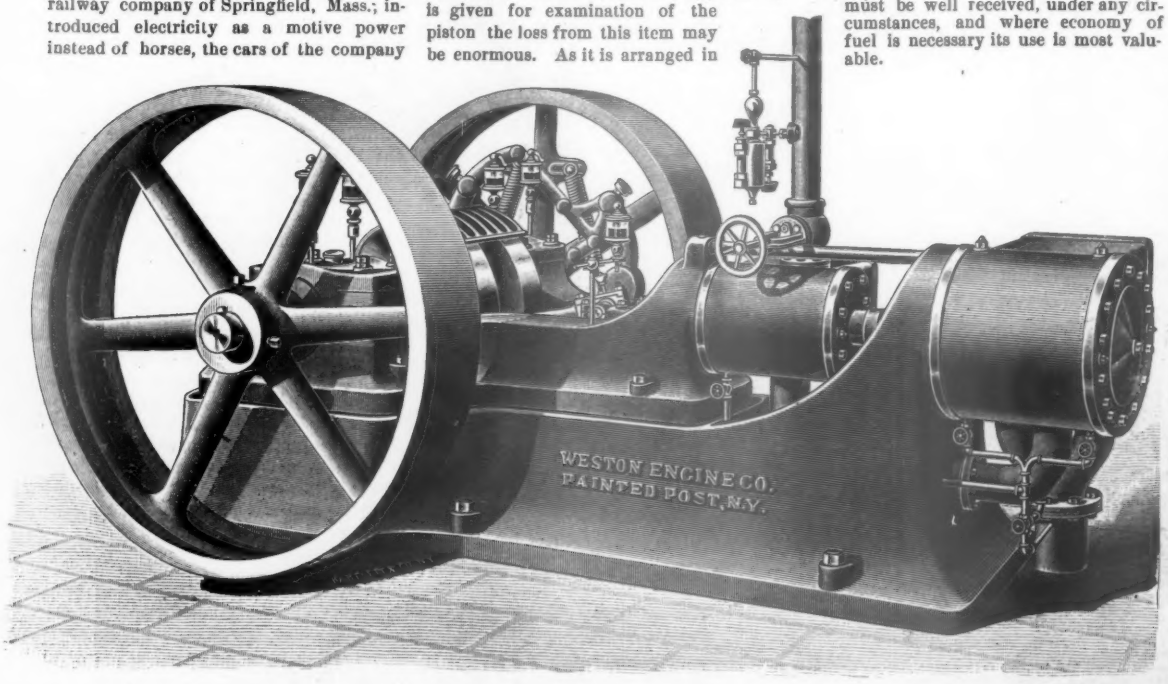


Fig. 1.—Weston Compound Engine.

Large Order for Turbines.

Eighteen large water-wheels were recently ordered of James Leffel & Company, Springfield, O., builders of the famous James Leffel water-wheel, by one firm. The turbines of this large order are to be used for driving a fine wood pulp mill, now under contract for construction in Wisconsin. This mill is situated near large quantities of suitable timber and where ample water power can be obtained.

Thomson-Van Depoele Electric Locomotives.

While electricity has been used for some time in mining work for the purpose of lighting mines, it attained no prominence in the field of underground haulage until the Thomson-Houston Electric Company designed and installed the locomotive in the Erie colliery of the Hillside Coal Company,

The Thomson-Van Depoele "Terrapin Back" Electric Mining Locomotive.

the first successful electric mining locomotive in the country. This was in October 1889.

Requirements of other mines, however, have led to the production of a locomotive differing essentially from that in the Erie colliery, a type known as the "Terrapin Back," and which is shown in the accompanying illustration.

It is most substantially and solidly built, the interior mechanism being entirely protected by a heavy iron armor, and possesses in a marked degree the important features of strength and solidity. The motor for operating the locomotive is of the iron-clad consequent pole type, having a Gramme ring armature.

It is provided with the radial type carbon brushes and elongated commutator segments, by means of which the most durable connection with the armature coils is obtained. The motor is situated midway between the axles, the proper speed reduction being attained by means of a train of gears. The locomotives can be run at various speeds, the motors being wound for any speed, at a maximum of from four to ten miles an hour.

The locomotive is provided with the necessary controlling devices all placed within easy reach of the operator. A special type of rheostat, composed entirely of mica and German silver, is employed, and a new and improved brake lever and reversing switch is used. The trolley arm through which the current is conveyed to the motor is of the double-elbow pattern, which accommodates itself automatically to the varying heights of the conductor, and permits the operation of the car in either direction. On each side of the locomotive is placed an incandescent lamp, which serves the double purpose of signal and headlight. A 220 volt generator supplies the necessary current. The Thomson Van-Depoele Electric Mining Company, of Boston, which designed this locomotive, has also in process of construction several new types, suited to the requirements of different mines, hard and soft coal, iron and other metals, and for high and low entries, and for gauges varying from 18 inches to the standard. The company having had such valuable experiences in the field of underground electric haulage is particularly fitted to design and manufacture any locomotive of any type demanded by local conditions. The success of the apparatus already installed has given great impetus to this branch of applied electricity, and will result in the still further use of electricity in mining operations.

A New Type "C. & C." Dynamo.

The accompanying illustration shows a 50 horse-power "C. & C." dynamo of a type recently placed on the market by the "C. & C." Electric Motor Company, 402 and 404 Greenwich street, New York city. The design is similar to that of the well-known circular field and consequent pole motor that has become so familiar to the public. The machine is wound for 500 volts and specially designed for power circuits. For long transmission of power this machine can be specially wound to give perfectly automatic regulation under very great variations in load. A substantial terminal board is bolted to the upper pole piece and is provided with a heavy knife switch for opening the main circuit. This board also carries the field and armature connections, all of which are of solid metal and in plain view. The commutator is of the most substantial construction, being built up of heavy copper bars insulated with the best mica, and with proper care it will last for years. The mechanical construction is of the best throughout, skilled mechanics being employed, with the most improved machine tools. The armature is wound to carry a much greater volume of current than the nominal capacity of the machine requires, thus making it practically impossible to burn it out by over-heating. The circular shape of the magnets give them the greatest development of power for least weight, and every part is so constructed as to make solidity and permanence the first consideration.

The 100 horse-power dynamo made by this company is of exactly the same form as the dynamo illustrated herewith, and is especially suitable to be used as a power generator for street railway circuits, its high efficiency and mechanical excellence making it a favorite with station superintendents.

These dynamos are wound in standard sizes, from one horse-power to 100 horse-power, for electric lighting as well as for power transmission, and especially for isolated plants and for use in mills, office buildings, etc. Although the "C. & C." electric motor company have but recently entered this field, the long list of people now using their dynamos for lighting purposes is the best possible indication of the success they are meeting with.

Trolley Roads are Run by a Polar Creation.

The trolley commission was in session again yesterday afternoon and the proceeding were made rather interesting when Sidney V. Lowell, one of the lawyers for the property owners who are opposing the introduction by Gen. Henry W. Slocum of the single trolley overhead system as a substitute for horses on Ninth avenue, called Prof. John B. Strong to prove the dangers of the dreadful trolley.

Professor Strong is an old man with a gray moustache and bald head. He told the commissioners that he was "a demonstrator of polar science." When questioned about the trolley system he said its chief danger lay in the falling of the wires. The professor added something about a "polar angle."

"What is a polar angle?" asked Commissioner Josiah J. Marean.

"I object," said Mr. Lowell.

Young Henry W. Slocum, Jr., who, with William N. Dykman, is looking after his father's interests, laughed aloud.

"I would like to hear the answer," said Mr. Dykman.

Mr. Lowell said that young Mr. Slocum, who had been well brought up, should not have laughed at the witness.

Young Mr. Slocum said he laughed at the idea of Mr. Lowell objecting to Mr. Marean's question.

The trouble was smoothed over and Professor Strong said that the trolley system was not run by electricity, but by a chemical or physical polar creation.

Lawyer Lowell read a clipping from a newspaper, stating that a man in Boston got enough electricity out of a water pipe on the top of his house to light the house and operate a burglar alarm. The supposition was that the fluid came from a trolley wire.

"That's a fine idea for a man to operate a burglar alarm with stolen electricity," said Mr. Dykman.

Professor Strong astonished the electricians present by telling them that there is no such thing as an insulator. He said he was the original inventor of the telephone and motor.

Lawyer Lowell asked the professor to produce his apparatus and show what he meant by a polar angle. The professor went to the rear of the court room and returned to the witness chair with a gripsack, which he opened in the presence of the commissioners. Then he took from it some electric batteries, wires, disks, etc., and proceeded to arrange them on a table.

Assistant Corporation Counsel Salmon, who appeared for the Park Department, expressed his fears that there might be an explosion and quietly left the room. Lawyer Dykman retreated to a safe distance and left young Mr. Slocum on reconnoisance duty. After the Professor had fumbled with the batteries and the wires and had been questioned and cross-questioned by Mr. Marean, the latter said, in a hopeless tone of voice:

"I haven't got the glimpse of an idea as to what the witness means. He makes so much fuss about words that it is impossible to get at anything."

"Is there anybody in the world that agrees with you?" Mr. Marean asked the Professor.

"Everybody does who has eyes to see," replied the Professor, loftily.

The Professor, in answer to another question, said he defied any one to show him that a current of electricity ever went through a human body.

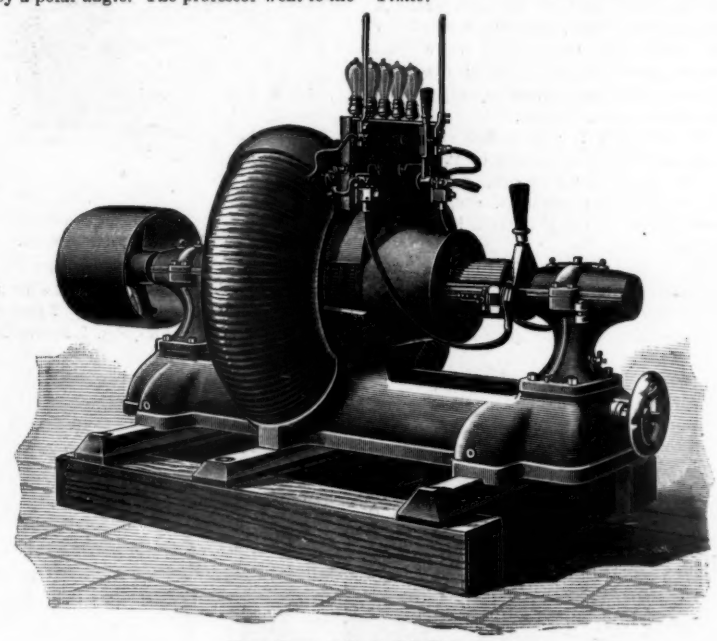
"What was your profession before you took up the study of the sciences?" was a question put to the Professor.

"I was an actor," was the reply, delivered with great majesty.

"What was your particular forte?" was the next question.

"Tragedy," replied the Professor, with a solemn wave of the hand.

The Professor retired and the commission adjourned until Wednesday next.—*Brooklyn Times.*

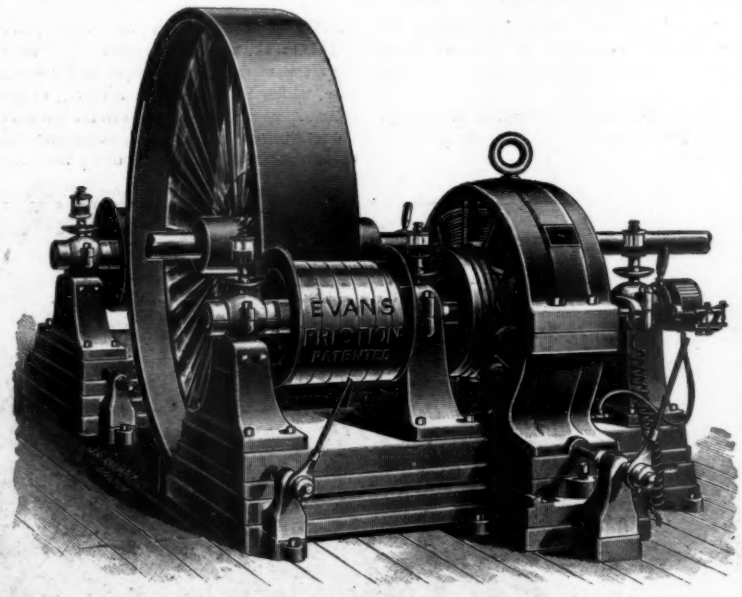


NEW TYPE "C. & C." DYNAMO.

Mitchell & Hungerford.

Hon. Charles E. Mitchell, having resigned the office of Commissioner of Patents, has resumed the practice of law, making a specialty of patent and trade-mark causes. The firm of Mitchell & Hungerford has been formed, with offices in the *Times* building, New York, and at New Britain, Conn., where the business of the firm will be conducted.

The Thomson-Houston Electric Company, on October 26, began suit in the United States Court against the Electric Merchandise Company, of Chicago, to enjoin an alleged infringement of patents for overhead conductors and switches for electric railways. An injunction restraining the use and manufacture of the devices is asked.



EVANS FRICTION DEVICE TO BE USED AT CLINTON, MASS.

There was entered in the Recorder of Deeds' office at Allentown, Pa., last week, a mortgage given by the Allentown and Bethlehem Rapid Transit Company to the Old Colony Trust Company, of Boston, for $500,000 to secure the first mortgage six per cent. gold bonds of the company.

ELECTRIC LIGHT NEWS

—— Tipton, Ind., is to be lighted with electricity.

—— Chippewa Falls, Wis., has substituted electric arc lights for gas on her streets.

—— An attempt is being made to organize an electric light company at Belleville, N. J.

—— The Greensburg, Pa., authorities have contracted with the electric light company for 50 arc lights at $80 each.

—— The illumination of the fine arts building, at the World's Fair, will require no less than 15,000 incandescent lamps.

—— A Belgian syndicate has obtained a concession for a monopoly of electric and gas lighting for the entire Persian Empire.

—— The Bessemer, Ala., Electric Company will repair and put in operation its electric light plant recently damaged by a boiler explosion.

—— The electric light company at Carlisle, Pa., has found it necessary to string an additional line to meet the demand for commercial lights.

—— The Edison Light and Power Company, of San Francisco, has filed a certificate with the county clerk that it has created a bonded debt of $800,000.

—— The San Antonio Electric Light Company has applied to the San Bernardino, Cal., trustees for a franchise to put another electric light system in that city. It will probably be granted.

—— The Shippensburg, Pa., Electric Light, Heat and Power Company has issued 50 bonds of $100 each. As a consequence, they have given a $5,000 mortgage to W. W. Stough, Dr. J. J. Koser and William J. Martin, trustees, all of Shippensburg.

—— The West Newtown, Pa., Electric Light and Power Company have purchased the gas company plant and will begin placing machinery at once. Two hundred arc lamps of 2,000 candle-power will be used to light the town and the plant will be in operation by Christmas.

—— A boiler in the Louisville, Ky., Electric Light Company's plant exploded last week, fatally injuring William Adams and wrecking the building. Fragments of the boiler set fire to a neighboring store and several people in it were injured. Loss, $250,000; covered by insurance.

—— At a regular meeting of the Cambridge, Mass., board of aldermen, last week, the president and fellows of Harvard College were refused permission to construct a conduit and lay electric wires under Cambridge and Kirkland streets, for the purpose of lighting the college buildings and grounds by electricity.

—— The city of Lambertville, N. J., has awarded an exclusive franchise for erecting poles and running electric light wires. A local company has been organized, to be called the Lambertville Electric Light Company, who have contracted with the New York Electric Construction Company to put in a plant.

The Evans Friction Device.

The illustration on this page shows clearly the well known Evans friction device for driving dynamos. The dynamos are of 650 lights capacity each, and are being built by the Thomson-Houston Electric Company, to be installed, with the Evans device as shown, in the electric light plant of the Clinton Gas Light Company, at Clinton, Mass.

Sawmills Run By Electricity.

All the sawmills at Jackson Park which the contractors use in cutting material for the World's Fair buildings will soon be run by electrical power. This order was given out recently, and Superintendent Geraldine will enforce it. Every steam engine, except the one used in generating power at the central station, will be moved from the grounds. Contractors have been ordered to substitute dynamos for steam engines. These dynamos are furnished by the Exposition company, and during the fair they will probably be on exhibition. As electrical power is furnished to the contractors free, all of them readily fell into the new order of things. Dynamos aggregating 360 horse-power have already been called for by contractors. The use of electrical power was determined upon to reduce the risk of fire to a minimum and to guarantee continuous work, both night and day, in the mills. Engineer Sargent, of the electrical department, has tested the central station several times and finds it equal to any demand that will be made upon it for either light or heat during the construction period.

Hunt's Electric Locomotives.

We illustrate herewith an eight-wheeled locomotive and a four-wheel mining locomotive, especially adapted for use in mines and manufactories. The motor of the locomotive, illustrated in Fig. 1, is secured to the car body between the tracks, with the shaft extended each way to a pair of beveled gears on each truck. Both the motor and gearing are carried on springs, which reduces the shocks on the commutator brushes and generally easing the strains on the machinery and on the road bed. A universal coupling is used on each end of this shaft, and immediately below this coupling is the king pin of the trucks; consequently the motor drives equally as well on a curve as on a tangent.

On this shaft is also placed an elastic coupling between the gearing of the motor, the two parts of which coupling are connected by rubber cushions, consequently the pressure on the gear teeth is substantially constant.

Fig. 2 shows a four-wheel mining locomotive, which is also adaptable to manufacturing use, where the utility of an electric locomotive is beyond question.

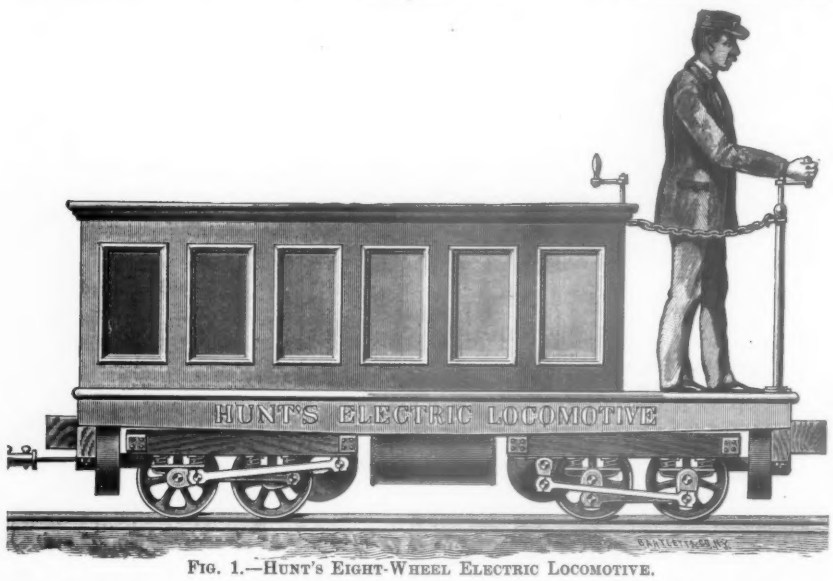


FIG. 1.—HUNT'S EIGHT-WHEEL ELECTRIC LOCOMOTIVE.

In mining work these locomotives are particularly applicable, because of their ability to take the smallest curves generally used.

The C. W. Hunt Company, 45 Broadway, New York, manufacture these electric locomotives.

The Cutter Incandescent Switch.

The Cutter Electrical and Manufacturing Company, of 27 South Eleventh street, Philadelphia, will shortly place upon the

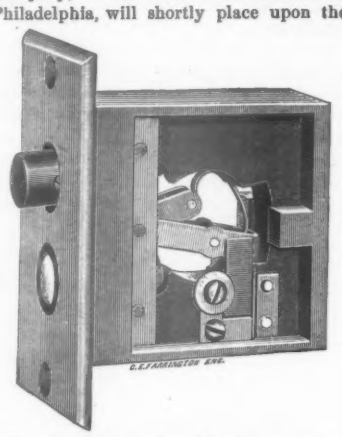


FIG. 1.—THE CUTTER INCANDESCENT SWITCH.—CLOSED.

market the novel incandescent switch shown in the subjoined illustrations. Fig. 2 shows the switch "open" while Fig. 1 shows it "closed." This switch is single pole, double break, with the brushes and switching mechanism mounted upon a porcelain base, which is enclosed in a casing of the same material. The copper terminal brushes are set over each other, the distance between them being seven-sixteenths of an inch, the end of the switch-bar acting as a bridge between them when the switch is closed, and giving a break of a quarter of an inch on each side when open, on an actual break of half an inch. The switch-bar is operated entirely by a flat semi-elliptical spring which acts eccentrically in such manner that, until the switching lever brings the spring to center, there is no movement whatever of the switch-bar; consequently, when it is moved past the center, the full tension of the spring is brought to bear for the break, which is absolutely instantaneous, so that with 10 amperes current, this size of switch,

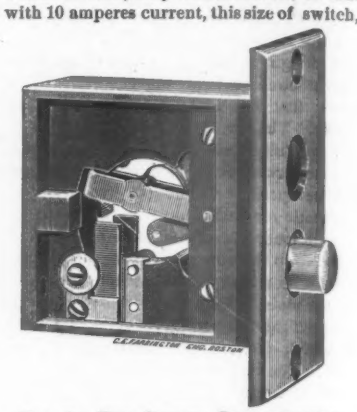


FIG. 2.—THE CUTTER INCANDESCENT SWITCH.—OPEN.

it is claimed, exhibits but the faintest indication of a spark.

The working parts are of hard brass plate put together in a substantial and workmanlike manner, in fact the mechanical and electrical construction of this switch is exceptionally good. Perhaps the most striking feature of the device is the fact that it is operated by two push buttons set into a face plate, which is set in place flush with the wall or surface of the switchboard, the porcelain case containing the switch mechanism being recessed into the wall, so that nothing is presented to view but the face plate which may be so ornamented as to correspond with its surroundings.

One of the push buttons is white, the other black. By pushing the white one the circuit is closed, while by pushing the black one it is opened, and in case the light governed by a particular switch is in a distant room, the condition of that light as to whether it is "on" or "off" is indicated by the relative positions of the push buttons. If the white button is flush with the surface of the face plate, the light is "on"; if this black one is flush with the plate, the light is "off."

The peculiar construction of this switch permits of an exceedingly convenient method of placing a number of switches in "gang" on the same face plate, in a manner similar to that adopted in electric gas lighting. For instance, a gang of 10 switches would exhibit only a face plate 15 inches long by 3¼ inches wide. The switch is also modified so as to be able to control one or more lights from two or more places.

ITEMS OF INTEREST.

Professor Elisha Gray, of Highland Park, Ill., laid some Okonite wire underground without any protection whatever, over three years ago, on which his telautographic experiments have since been conducted. The wire is still in perfect condition, showing an infinite insulation resistance. The Central Electric Company report that they never have any comments on this superior grade of insulation, except such as are favorable, and of which the above is a sample. The Central Electric Company are pushing the sale of Paiste switches, of which they have a large stock, and can fill almost any kind of an order from their warerooms.

H. Ward Leonard & Company, New York, have received the following letter:

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

BROOKLYN, October 22, 1891.

MESSRS. H. WARD LEONARD & Co.,
Electrical Exchange Bldg., N. Y.

Gentlemen: We have just permanently equipped our passenger elevator with your new system of motor power, and are greatly pleased at the result. The arrangement is perfect in its absolute control of the elevator car, and requires very little attention in its operation. As the current on the motor is constant, whatever the speed may be, the neutral point is fixed and the brushes require no adjustment to prevent them from sparking.

In this system the motor operates continuously at its highest efficiency and there is no likelihood of the armature burning out, due to sudden changes of load. We are able to instantly reverse the car and motor, at any speed, without any strain whatever, while the motion under all conditions is similar to that of a hydraulic elevator.

Should any one desire to investigate this system they can see it in successful practical operation at this station.

Yours truly,
[Signed] W. S. BARSTOW,
General Superintendent.

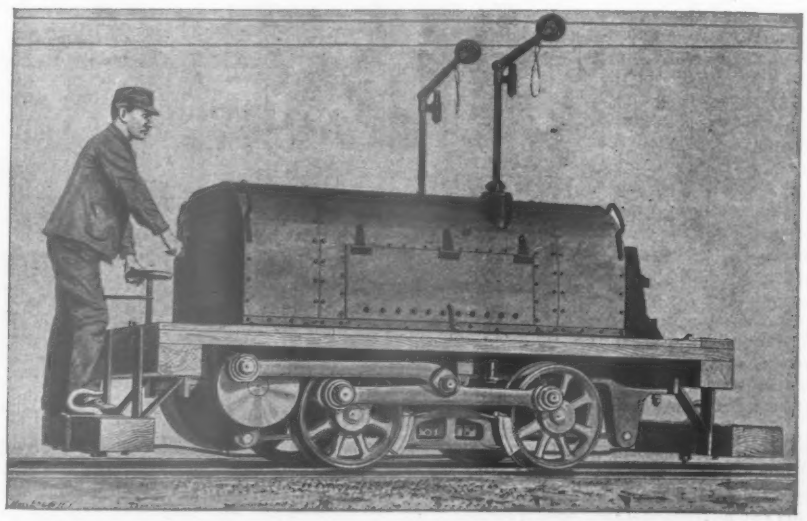


FIG. 2.—HUNT'S FOUR-WHEEL ELECTRIC LOCOMOTIVE FOR MINE HAULAGE.

The completion of the city electric railway system, which may extend to all the precincts and suburbs of Joliet, Ill., and connects Lockport, and the addition of a number of magnificent new eight-wheeled Pullman electric coaches was fittingly observed last week by an excursion over the lines by the city officials in charge of the president of the system, J. A. Henry.

H. T. Paiste, manufacturer of electrical specialties, owing to increased business, has been obliged to move his factory and eastern office from Twelfth and Market streets, Philadelphia, to the new Fuller building, 10 South Eighteenth street, below Market, in the same city. He has taken the entire third floor of this elegant building, thereby trebling his floor space. It is the intention of Mr. Paiste to largely increase his line of specialties. The western office and storeroom, 341 The Rookery, Chicago, remains unchanged.

Magnetic Reluctance.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, OCTOBER 27, 1891, BY A. E. KENNELLY.

The science of magnetism was a collection of facts concerning magnets until Coulomb first brought to light a quantitative relation between a few of its phenomena and thus entitled it to appear among the exact sciences. He determined by measurement that the forces of attraction or repulsion between the poles of long thin bar magnets were proportional to the strengths of those poles and inversely to the square of their intervening distance.

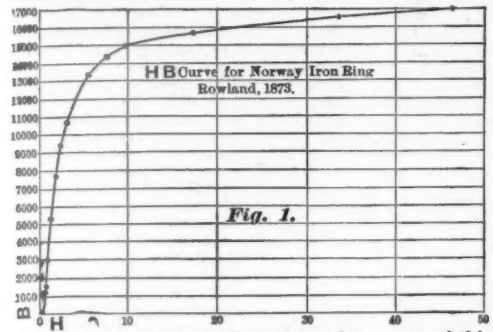


Fig. 1.

In one respect, it has since been shown that the discovery was unfortunate, for it served to depress rather than to stimulate further inquiry into the laws of quantitative magnetic relationships. The application of Coulomb's law soon brought into use a conception of magnetism suggested, perhaps, by the analogy the law bears to that of gravitation force. This was the hypothesis of a layer of fluid or imponderable matter resident on the surfaces of magnetic bodies and endowed with attractive and repellent forces on all portions of such fluid, in exact similarity to the two fluid theory of electricity. Each element of surface magnetism would exert, according to Coulomb's law, a definite force upon every other element of its own, or of other magnet surfaces, and when the distribution of the magnetic matter or fictive layer was known, the total forces active between the magnets forming the system could be determined by the summation of all the elementary actions. This was the polar conception and mathematical theory of magnetism. It was not only artificial, it was also misleading. It assumed that definite action could be exerted at a distance, ignoring the action of the intervening medium. Nevertheless, a slight modification of the polar theory rendered it capable of expressing a mathematical theory of magnetism with apparent success, and exhibits in this respect, like the theories of gravitation, the remarkable construction of purely artificial frameworks of thought, void of all attempt at reality, yet capable of affording useful applications and exact quantitative results, while beneath their foundations the real and active natural forces still lie in undiscovered concealment.

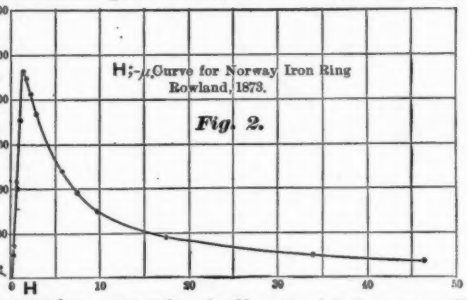


Fig. 2.

It was soon apparent that magnetism considered as a fluid could not be confined to the surface of bodies, since it was only necessary to break a bar magnet asunder in order that new poles and new magnetic fluid should be exhibited. The amendment to the original theory was then framed that a condition of molecular magnetization extended, vein-like, throughout the substance of the magnet. The termination of each vein at the surface exposed a definite quantity of polarized magnetic matter, while within the veins the polarity was neutralized by the successive layers of opposite molecular poles. This was a great stride beyond the original theory, for it ascribed magnetism not alone to a fictive superficial layer, but to the combined effects of all the molecules in the magnetized body, whose substance, no longer a mere frame for supporting the layer, became invested throughout with a definite condition.

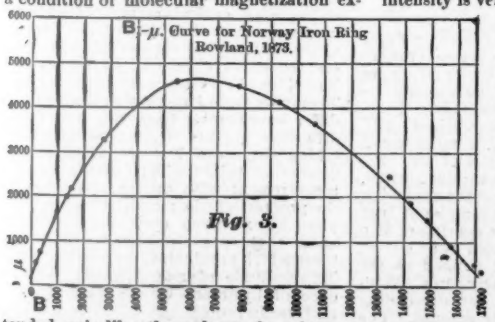


Fig. 3.

The amendment in time became classical, and subverted the original conception, for the polar theory only recognized superficial magnetism, while the vein theory did not make any such reservation. It was only necessary to assume that the veins varied in richness at different parts of the magnet, or that they might be subjected to faults and partial discontinuities, to introduce unneutralized polarity within the mass which might be capable of exerting external influence, a condition neither the simplest nor most usual, but which the experiment of superposed magnetizations in steel has rendered familiar. This irregularity of vein structure would add a volume distribution of magnetic fluid through the interior of the magnet to the surface distribution on the outside.

On the vein theory, the intensity of magnetization at any point of the magnet would be defined as the amount of magnetic matter cut through in the veins per unit area by a plane section perpendicular to their direction, at the point in question.

A unit magnetic pole situated in free space, at the end of a very long thin bar magnet would, by definition, repel with unit force a similar pole one centimetre distant, that is, resident on the surface of a sphere one centimetre radius, of which it occupies the center. The surface area of this sphere would be 12.57 (4π) square centimetres, and over all this surface the pole would thus establish a magnetic field of unit strength and exert a magnetic stress equal to unity. Each square centimetre of the surface bounds an area of stress which emanates from the pole, and, consequently, the latter must emit 4π units of stress flux. In the language used by Faraday it would throw off 4π lines of force. This stress flux has somewhat unfortunately received from Maxwell the name of induction, and the induction through the surface surrounding the pole would be 4π units.

The interest connected with the nature of this stress demands a moment's pause at this point. While its real character is still as great an enigma as the real character of magnetism itself, some of its laws are well understood. There exists along the direction of the stress a tension accompanied by a general pressure at right angles, just as in the case of stimulated muscular fibre which tends to shorten and to expand laterally, or as it is generally expressed, the lines of force tend to contract while repelling one another. Since the time of discovery that the plane of undulation in polarized light waves twists in passing through certain magnetized substances it has been supposed that the stress might be of a rotatory character. Like an incompressible fluid it can neither accumulate or vanish locally, and as much stress flux must leave any region as enters it, if no magnetic pole exist within the confines. Its intensity is very remarkable, for it is far in excess of any stress that we can exert without the aid of cohesion in matter. This may be judged by comparing the quantities of energy that can be stored in a given volume of space—say, air space. It is, of course, easy even without the assistance of iron to magnetize a cubic centimetre of air to a flux density of 5019 C. G. S. lines when it will possess an energy stored up in magnetic stress of one megalerg (1,000,000 ergs or 0.0737 foot-pound) while if this magnetization be alternated 227 times per second, the average rate of absorption and discharge would be 45.5 watts, and one cubic inch of this air would stow and release energy with the average activity of one standard British horse. Under electrostatic stress, air not in the immediate neighborhood of a conductor appears to break down when the electromotive force per linear centimetre exceeds 32,000 volts or 110 A. E. S. U., so that the maximum electrostatic energy that one cubic centimetre will hold without rupture is about 500 ergs or 2,000 times less than that resident in air stressed magnetically to 5,000 lines, while a cubic centimetre of air near the earth's surface, illumined by bright sunlight, does not hold more radiant energy than about 50 microergs.

An alternating current transformer is a device in which the secondary coil absorbs the energy out of air and iron, pervaded by the stress flux from the excited primary coil. Unfortunately, while magnetically stressed, air yields, so far as we know, all its stress energy back into either the primary or secondary circuit, stressed iron fails to do so entirely, and absorbs energy at every cycle, a process known as absorption by hysteresis. The iron directly converts the magnetic stress energy into heat energy, just as a spring absorbs some of the energy imparted to it during every cycle of compression and recoil.

These 4π units of stress flux are not confined to a spherical surface of one centimetre radius, but would be found by summation over any enveloping surface containing a single unit pole, just as the delivery of material liquid must be the same in a steady stream at any section of its course, independent of the channel area then existing; for, at ten times the distance, the spherical area would be 100 times greater and the stress by Coulomb's law 100 times less, leaving the total area of total stress unchanged, and it follows in fact that the stress flux over any boundary is always 4π times the strength of poles enclosed, no matter whether that pole be alone in space, or be the sum of any number of magnetic systems, in molecules or in masses.

On the vein theory, however, the strength of a pole is the quantity of magnetic matteron its surface, assuming that the veins meet it perpendicularly, or it is the aggregate surface intensity of magnetization, so that the stress flux through each unit of polar surface is 4π times the intensity of magnetization. This is true not only for the polar surface, but also for the interior of the magnet, and every unit vein of magnetic polarized matter carries associated with it a stress flux of 4π.

The magnet may itself be situated in a field of force so that its substance may be pervaded by a stress flux independent of that in its veins. It may and generally does happen that part of this separate stress flux issued from its own poles, in which case it will enter in the opposite direction to the vein or internal flux and will tend to reverse the molecular polarity of the vein structure, but whenever such additional flux is present, the resultant total flux at each point will be the geometrical resultant of that in the veins compounded with the external flux by the parallelogram of forces. In the important case of a long bar of homogeneous soft iron submitted to the influence of a uniform magnetic field acting in the direction of its length, there will be a uniform induced molecular polarization or magnetization set up along the bar. Suppose, for instance, a bar of iron five square centimetres in uniform cross-section pointed in the direction of the dipping needle near Paris. The earth's field there being 0.46 unit, or its stress flux 0.46 units over each normal square centimetre, that stress would be active in setting up polarity in the molecules of the iron along the bar. The degree of magnetization would be also influenced by its own resulting polar stress unless this effect could be rendered insensible by sufficiently extending the length and thus carrying the poles out of the field. With a very long bar magnet the magnetization would be everywhere about 40 times this strength of field, or, numerically, 18.4 units, and on the vein theory there would, therefore, be 18.4 units of magnetic matter exposed on the surface of each square centimetre in a slice made across the bar at any point, or 92 units over the whole section. The polar surfaces would also be covered by 92 units of positive and negative matter, respectively. Associated with each unit vein of polarity, however, would be 4π units of stress flux giving a total flux of 1,156 units in the bar which would emerge from the polar surfaces and unite in surrounding space. The whole induced system would, however, be immersed in the earth's field that evoked it and which would be superposed upon it throughout. There would thus be 1156+2.3 or 1158.3 units of flux, in ordinary phraseology 1158.3 lines of induction through the bar, a density of 231.6 C. G. S. units per square centimetre. The law that the whole flux is the field flux compounded with the induced flux of 4π times the magnetization, which holds uniformly at all points throughout the bar, in this simple case is true at any individual point in the most complex case, however variable the field or magnetization may be.

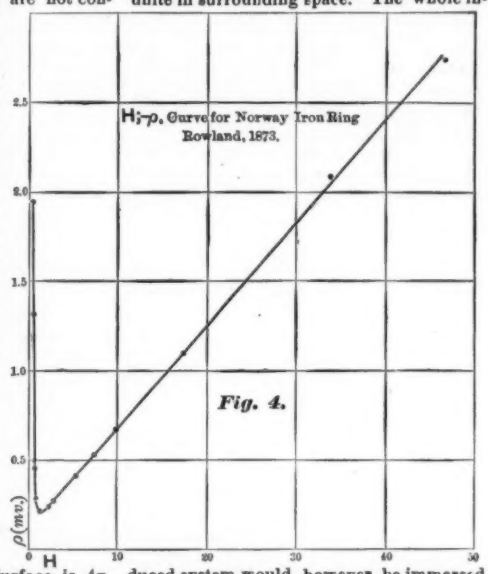
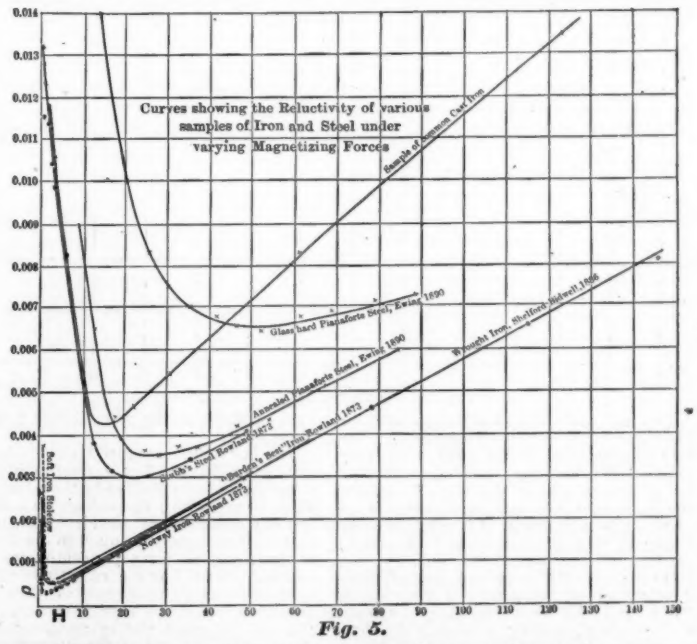


Fig. 4.

The fact that the stress flux has the same total value over any envelope surrounding a magnetic pole, however widely the stress may be diffused and rarified, that it follows


Curves showing the Reluctivity of various samples of Iron and Steel under varying Magnetizing Forces
Sample of common Cast Iron
Glass hard Platinoforte Steel, Ewing 1890
Annealed Jessop's Steel, Ewing 1890
Wrought Iron, Shoffield Holtzell 1868
Swedish Steel Rowland 1873
Swedish Best Iron Rowland 1873
Norway Iron Rowland 1873
Soft Iron Stalloy
ρ
H
Fig. 5.

curves in space whose existence can be rendered evident by iron filings and curves that form closed loops through the substance of the magnet itself, gradually suggested the notion of a magnetic circuit in which the circulation was neither a fluid nor an energy-exchanging condition, like a current, but a stress.

This conception, once firmly established, proved of great advantage. Not only has the dynamo been greatly aided in development by the applications of this theory, but the inter-relationship between magnetism and electricity has been brought into clearer recognition in consequence. From this point of view the ideas and analogies of the galvanic circuit became paramount and eclipsed the original notions of magnetic

matter and magnetization. All that was essential on this hypothesis was a magneto-motive force in a circuit having conductivity, and a flux or magnetic current resulted. The magneto-motive force in permanent magnets was the result of a definite molecular condition in the iron, while in the neighborhood of an electric current it was always active. According to Ampere's theory that magnets had molecules in which electric currents ever circulated, the two sources of magneto-motive force were united.

Some contention took place between the claims of the vein theory and the circuit theory for the interpretation of magnetic phenomena, and the question as to their relative merits is yet often raised. It seems, however, early to decide upon the acceptance of any theory while the ultimate origin and nature of magnetism remains unexplained, and it is better to regard both theories as working hypotheses to account for the effects of magnetic laws, equally capable of yielding correct results and, therefore, closely associated, while the preference between them will depend upon the nature of the problem to be attacked. The circuit theory is the simpler for general puposes of theory, and particulary for dealing with the phenomena of electro-magnetism. The vein theory, on the other hand, while very artificial, is often more convenient in dealing with the magnetic behavior of the three metals, iron, cobalt and nickel, and it is the natural accompaniment of Ewing's modern theory of magnetization, which at present appears to best represent the facts.

On the circuit theory the magnetic conductivity of all substances is very nearly the same as that of an air-pump vacuum, and constant, notably accepting the three magnetic metals whose conductivity is enormously greater, but variable with the conditions of the circuit.

The existence of magnetic conductivity known as "permeability" necessarily involved the inverse quality of magnetic resistance.* Some debate has taken place as to the validity of this term or its application, for the reason that the resistance which usually enters into practical magnetic circuits is generally far more variable than that found in the metallic circuit of electricity. It is now generally admitted, however, that the term magnetic resistance is fairly applicable in virtue of analogy, if not of exactitude. The term magnetic reluctance, then, suggested by Heaviside, has, however, the advantage that "reluctance" as one word is less cumbrous than "magnetic resistance," and for that reason only it is advantageous to retain it. Similarly the reluctance per unit volume or the magnetic resistance of one cubic centimetre has been called "reluctivity" and is perfectly definite if not quite euphonious under that title. It is this quantity which will occupy our further attention.

This magnetic circuit differs from the galvanic in one important particular. In the latter we most frequently meet with a conductor carrying the flux or current through an insulating medium, such as air, in which no current—certainly no measurable current—passes. In the magnetic circuit this condition of things, while approximated to and often for practical purposes assumed in dynamos or electro-magnets, is only realized in one actual instance—that of a closed Faraday ring uniformly wrapped with wire carrying a current. In every other real case the flux is diffused more or less through the surrounding substances and does not follow a simple passage. Magnetic flux, in fact, is not to be enchanneled because there is no known magnetic insulator, and this fetters by complication the quantitative grasp of the subject.

The law of the magnetic circuit is like Ohm's law that the flux is equal to the magneto-motive force divided by the reluctance. That is, regarding the circuit as a whole. For any one point of the circuit the law is that the flux density is equal to the drop in magneto-motive force per centimetre there existing, divided by the reluctivity—corresponding exactly to the case of Ohm's law at any point in an electric circuit. This "drop" is called the magnetizing force, denoted by H, and is the strength of the magnetizing field at the point. Owing, however, to the great variation that exists in the reluctivity of iron, which enters into nearly every practical magnetic circuit, the law is of much less service than Ohm's electric law. The reluctivity depends not only on the magnetizing force, but also on the degree of purity of the iron, and iron possessing 12 per cent. of manganese is almost non-magnetic.*

A number of attempts have been made by different observers to establish a definite relationship between the flux density and the magnetizing force or the permeability, in order to so amend the magnetic Ohm's law as to give serviceable results for even pure iron. The results obtained, excepting the formulæ of Frölich and Lamont, have generally been regarded as unsatisfactory. They have usually been expressed graphically as curves in one of three types:

1. H—B, or curves of magnetizing force and flux density.
2. H—μ, or curves connecting permeability and magnetizing force.
3. B—μ, or curves connecting flux density and permeability.

It is the object of this paper to show that there is a fourth relation that has not received the attention it seems to deserve—namely, the curves connecting the reluctance with the magnetizing force.

As an example of the comparative forms of these well known curves, types 1, 2 and 3 are represented in Figs. 1, 2 and 3 for a sample of Norway iron whose results are among the first on record, being published in 1873.* The curve connecting the reluctivity with magnetizing force is shown in Fig. 4 and exhibits a greater degree of simplicity than any of the others. Curve 4 consists, in fact, of two lines that are very nearly straight, united by a rounded elbow; and these outlines express the fact that the reluctance of H. The flux density existing in this sample of Norway iron can be calculated by the Ohm's law formula for any value of H when the corresponding value of the reluctivity is taken from one or other of these two equations and the resulting curve of B—H will practically coincide with that in Fig. 1, except in the immediate neighborhood of the critical value of H. This relation also exhibits the foundation that exists for the Frölich formula, which has long been known to be practically valuable and even very accurate in application to dynamo-magnetic circuits, although both the method by which it was arrived at and the light in which it has since been regarded appear to have been empirical rather than fundamental.*

Fig. 6 shows that the minimum reluctivity for soft iron is about 0.15 MU, while its initial reluctivity is about 3.0 MU. The critical value of H is also in the neighborhood of 2. If any critical H can be said to exist for glass hard pianoforte wire, it would be in the neighborhood of 35 units, and every description of hard or impure iron met with in practice, not containing much manganese, appears to have its critical H between these limits. These reluctivity curves also illustrate perhaps more clearly than any others the leading features of Ewing's theory of magnetization. There is, first, the initial stage of diminishing reluctivity, during which the imaginary molecular magnets are being deflected from their original configurations, then a short critical range of magnetizing force in which nearly all the original groupings are disrupted at the point of lowest reluctance, and, finally, a steady increase of reluctance as the molecules are gradually forced by increasing magnetic stress into parallelism.

This bilinear characteristic curve of reluctivity is not confined only to iron. Fig. 6 shows the same general outlines in the case of nickel taken from the observations of Rowland and Ewing. Here the initial reluctivities are higher, and the descent to the critical points much sharper than in iron, while the ascending lines are also steep, but nearly straight.

Taking the equation $\rho = a + bH$ in the ascending curve, the first term a only disappears in one known instance—that of nickel under a mechanical stress of 19.8 kilograms per square millimeter or 28,160 pounds per square inch—as seen in Fig. 7 taken from Ewing's results. The lowest ascending curve prolonged downwards almost meets the origin. Consequently, the flux equation for such nickel would be

$$B = \frac{H}{bH} = \frac{1}{b} = \frac{1}{0.000177} = 5{,}650,$$

and this flux is practically constant for any magnetizing force within further considerable limits, representing early saturation. The influence of compression in diminishing the reluctance of nickel is clearly shown in Fig. 7. The critical reluctance is gradually diminished by the stress applied from 14.5 MU at H 30 to 2.6 MU at H 12.

Fig. 8 gives the corresponding curves for cobalt. The same features are again observable. Only in one case, that of cast cobalt at 230° C, is there any considerable deviation from a straight line in either rise or descent from the critical segment of the curve, and this represents a series observed by Rowland under some experimental difficulties and alluded to as somewhat doubtful.

We have now examined the reluctance of the three magnetic metals collected from all the best known experimental observations. In addition to these it appears that every reliable series of tabulated results for iron, pure, impure, cast or forged, exhibits the same types of bilinear reluctance referred to H between 0 and 150, although in very hard or impure specimens there is no clear indication of a critical point. This assumes however, that the observations are not vitiated by residual magnetism. For example, the curve obtained by plotting the reluctivities of cast iron, as quoted by Silvanus Thompson from Hopkinson's observations,† differ considerably from this type, but the difference appears to be accounted for by taking the mean between ascending and descending values. The ballistic method of measurement with anchor rings, in which the progress of the magnetizing force takes place by extending reversals, gives reluctances that appear to be as nearly linear as those which are obtained by a single increasing amplitude of magnetization, the influence of hysteresis being apparently nearly uniform in ratio.

An examination of reluctivity curves naturally suggests the question as to whether there is really a strict linear relationship between H and ρ. In other words, whether the divergences of the observation curves from geometrical straight lines can be fairly

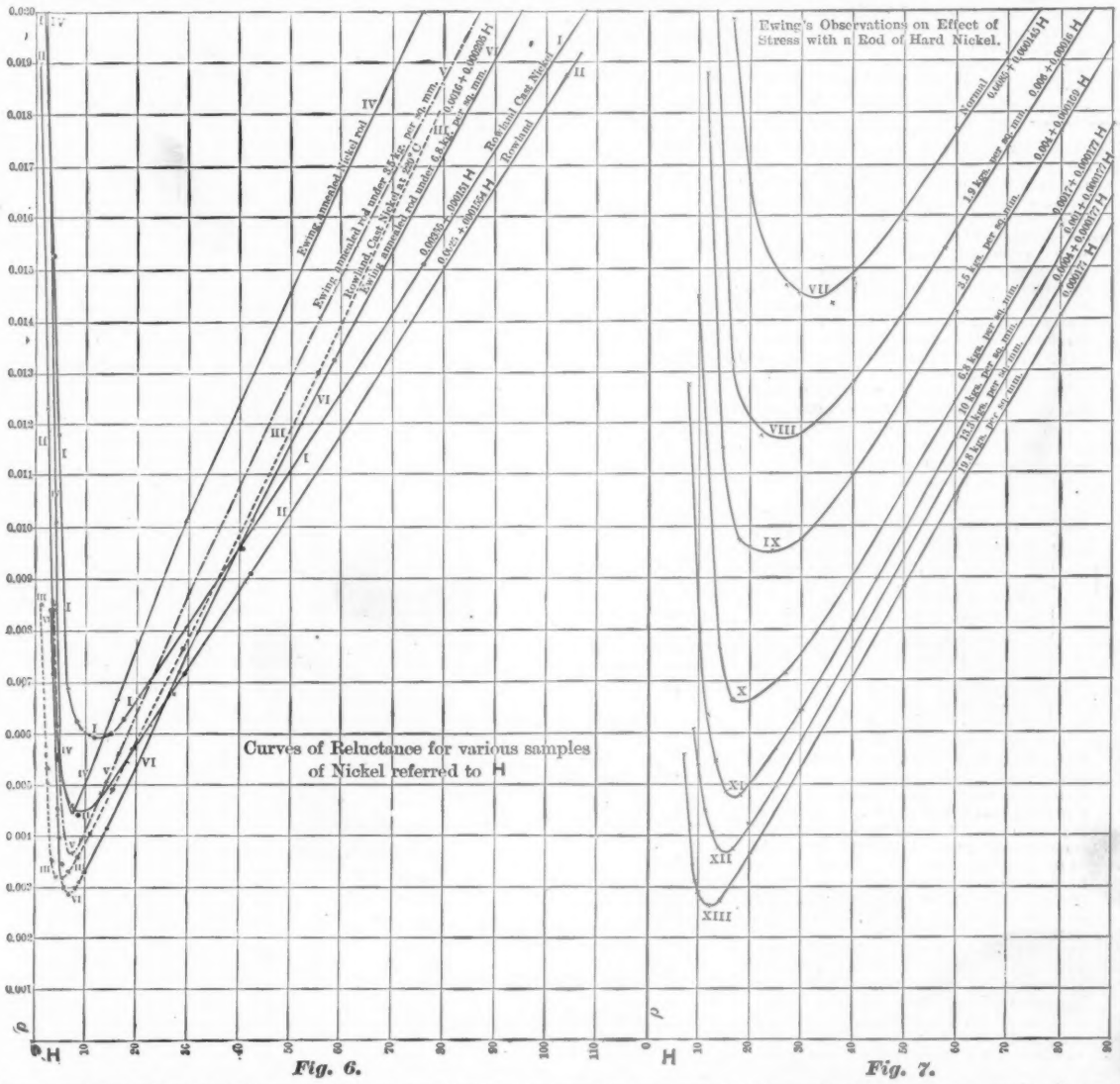

Curves of Reluctance for various samples of Nickel referred to H
Ewing's Observations on Effect of Stress with a Rod of Hard Nickel.
Normal
1.9 kgs. per sq. mm.
3.5 kgs. per sq. mm.
6.4 kgs. per sq. mm.
10 kgs. per sq. mm.
13.3 kgs. per sq. mm.
19.8 kgs. per sq. mm.
Ewing, annealed nickel rod
Rowland, Cast Nickel at 230° C.
Ewing annealed rod under 6.8 kgs. per sq. mm.
Rowland Cast Nickel
Rowland
H
ρ

Fig. 6. *Fig. 7.*

* Bosanquet. *Phil. Mag.* Vol. xxv, 1888, p. 419.

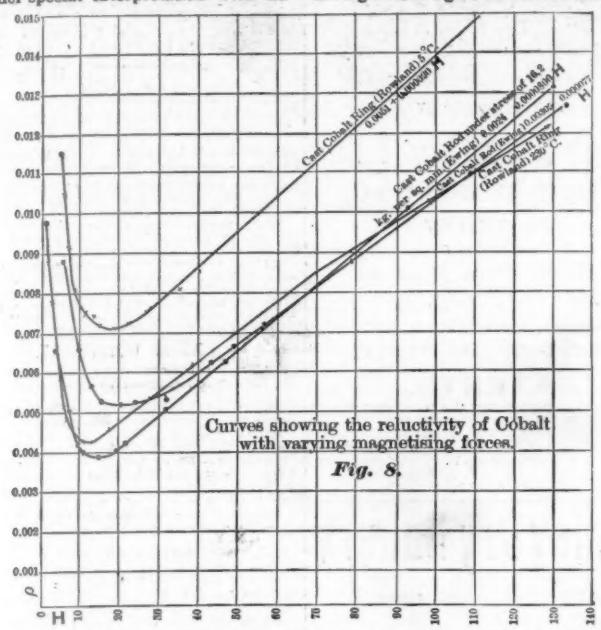
* Hopkinson. *Phil. Trans.* 1885, part ii, p. 462.

* Rowland. *Phil. Mag.* 1878, p. 158, table v.

* Frölich. *Electrotechnische Zeitschrift.* pp. 90, 122, 1881; p. 73, 1882.
Silvanus Thompson. "Dynamo Electric Machinery." p. 305. "Lecture on the Electro-magnet." I. p. 74.
Ayrton and Perry. *Phil. Mag.* 1888, vol. xxv. p. 506.
† Silvanus Thompson. "Dynamo Electric Machinery," p. 302.

ascribed to errors of observation, allowing for the influences of residual magnetism.

First, confining the inquiry to the ascending reluctivity line—that which is geometrically consequent upon Frölich's formula and also under special interpretation with La-


Cast Cobalt Ring (Rowland) 8°C.
Cast Cobalt Rectangular strut of 14.8 sq. per sq. inch (Ewing) 8.0024
Cast Cobalt Rod (Ewing) 0.0 cross
Cast Cobalt Ring (Rowland) 230° C.
ρ
H

Curves showing the reluctivity of Cobalt with varying magnetising forces.

Fig. 8.

mont's formula—the agreement of the plotted observations with a straight line between the neighborhood of the critical H and H=150 is often so good as to intimate the existence of a definite linear relationship. It is generally to be found, however, that beyond 150 C. G. S. units of H, the line bends downward until all hope of rectilinearity is lost. That is on the simple circuit theory of reluctance. If, however, we introduce an amendment into the definition of reluctance borrowed, from the vein or polar theory, the rectilinearity appears to be nearly sustained for a much greater distance. Experimental observations of the reluctances in circuits of the magnetic metals under powerful magneto-motive forces are yet very scanty, but judging from the results of Ewing and Low* the reluctivity of wrought and cast iron on the amended definition appears to be a linear or at least nearly linear function of the force as far as H 25,000 and H 11,000, respectively, the limits of the quoted measurements.

The graphs of these measurements are given in Fig. 10. The observations run from H 3,630 to 11,200 for wrought iron with an isolated observation at H 24,500 in a separate instance, the similar series for cast iron running from 3,900 to 10,610 units of H. The linear relationship is very fairly maintained and the lines prolonged downwards nearly strike the origin. It is to be observed that at the limiting observation for wrought iron its reluctivity is nearly 20 per cent. greater than that of air or of the air pump vacuum.

According to the simple circuit theory, the reluctance is, of course, the ratio of the magneto-motive force to the flux and the reluctivity this quantity locally reduced to the unit of volume. On the vein theory, however, which, as we have seen, distinguishes the vein flux from the magnetizing flux superposed thereon, the conductivity of a mass of iron is the conductivity of the iron itself added to that of the space it occupies, and, consequently, applying the vein theory to the magnetic circuit, we have the apparent reluctance of the iron mass as the joint reluctance of two paths in multiple arc, one through the iron itself and what might be called its metallic reluctance, the other through the reluctance of the space occupied by the iron, and the removal of the iron would leave this latter unaltered. The difference between the apparent and metallic reluctance is inappreciable, while the latter remains small, that is, generally speaking, when H is below 150, a limit rarely exceeded, and, consequently, the question does not present itself under practical conditions, but for large values of H, the difference is considerable and the metallic reluctance approaches the linear relationship with H, while the apparent reluctance deviates considerably from it.

These assumptions from the vein theory, while they may be convenient, are somewhat artificial, for they postulate that the space reluctance of a given volume of air is not altered when the volume is occupied by iron. This may not be impossible, but it is difficult to imagine any reluctance mechanism of ether that would remain undisturbed by the introduction of a massive substance. On the other hand, while the vein theory imposes this principle not touched upon by the circuital hypothesis, it explains very satisfactorily the fact now apparently beyond dispute, that while iron can be saturated there is no limit yet attained to the flux density that can be made to pass through it. Ewing's results give no limit at the observed flux density of 45,350 *CGS*, nearly three times the flux density at which iron is commonly worked in practice, while at the same time they indicate a limiting value of magnetization long before that density is reached. Following the vein theory, the polarization

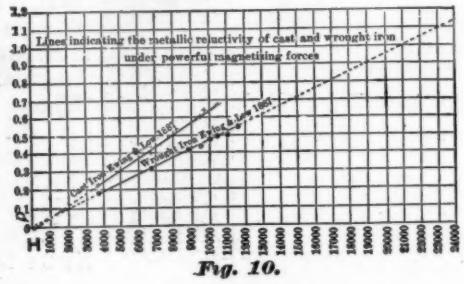


Fig. 10.

of the iron is then complete and the intensity of magnetization or magnetic matter per unit cross section of veins finds its maximum, so that while the total flux can go on increasing indefinitely, it can only do so by adding to the permeating field flux, the vein flux having reached its full limit. It is not impossible to represent the observed condition of affairs by the simple circuit theory, but the mental picture is not so clear. It would be possible, for instance, to imagine that the molecules of all substances transmitted the stress flux with the same, or almost the same, facility as the ether surrounding them, but that in the magnetic metals they exalted the stress in transmission. Maxwell supposed that the iron molecules were so constructed that they could take part in the ether spin that might constitute the stress, and if so by adding to it their momentum of revolution they could augment its value. There would be then, perhaps, at a certain stress, a speed of revolution which the iron molecules would not exceed, and their reinforcement would be at a maximum, while for stresses enormously greater than this the molecular augmentation would be lost in comparison with the strength of field, and the iron molecules would in the aggregate behave almost like the motionless transmitters of other substances. The consequences of this conception seem more complex, even if more nearly true.

Turning, now, to the descending curve of reluctivity between the initial and critical values, closer examination will show that here at least the linear relation is only an apparent one. The descent is so steep that on the scale of projection it appears nearly straight, but when magnified it has a distinct curvature. Raleigh* and others have shown that for very small degrees of H the permeability commences with a definite steady value, and this being the case it would be impossible for the reluctivity—the reciprocal of that permeability—to be linear towards H. Series of observations covering with sufficient detail the range of H from zero to unity are apparently few, and Fig. 9 gives the plotted values of the reluctivity on an enlarged scale observed by the writer for a sample ring of Norway iron. The descending line has a marked curvature,

* *The Electrician*, London, 1890, July 25 & Aug. 1.

* *Phil. Mag.*, March, 1887.

approximately logarithmic, that would be almost inappreciable however on the scale of the other reluctivity diagrams.

Even, however, if we admit that there exists a linear relationship between H and ρ beyond the critical point, that is to say, if the experimental results justify the belief that Frölich's formula is not merely an empirical one, we are scarcely entitled to attribute to this relationship an intrinsic physical signification. It may enable us to grasp the salient features of the magnetic circuit by the re-establishment of Ohm's law, but the relationship is more likely to be the consequence of a more remote fundamental agency than to be significant of any physical condition resident in metallic reluctivity itself. This is for the reason that the increase of flux under magneto-motive force in a magnetic circuit, due to the presence of iron, is probably owing to an assisting magneto-motive force set up in that iron under stress than to any change in the latter's reluctance, and the removal of the initial source of magneto-motive force from the circuit still leaves some magneto-motive force active as residual magnetism.

The case is similar to that of an electric circuit containing a polarizing electrolyte. It might be more simple to ignore the counter electromotive force of polarization and to regard the resulting diminution of current as the result of an extra resistance whose value might be tabulated or possibly even reduced to simple laws. So again in alternate current circuits it is often more convenient to speak of a resistance coil with inductance as possessing an impedance greater than its ohmic resistance, and to determine the flow of current on the basis of impedance calculated to the original electromotive force, whereas the direct and fundamental method would be to keep the resistance at its true value and determine the current by allowing for the counter electromotive force of inductance in quantity and in time.

Retaining, then, the latter analogy, we may say that flow in an electric circuit is subject to Ohm's law simply when the electromotive force is constant, but when the effective electromotive force varies periodically, the resistance has to be increased by a definite amount, depending on the inductance and the manner of fluctuation in order to obtain the correct effective current under those conditions. Similarly that the flux in a simple magnetic circuit of air or vacuum is subject to Ohm's law, but that if the circuit includes a magnetic metal, the reluctance in the formula has to be changed in a definite way depending on the quality of the metal and on the magnetizing force in or to obtain the corresponding true flux density. The change in reluctance is the ideal connection of a shunt metallic circuit in parallel with the air circuit, and the reluctivity through the metal is nearly a^1-b^1H for values of H below the critical and $a+bH$ for values beyond, with a little uncertainty in the vicinity of the critical point itself.

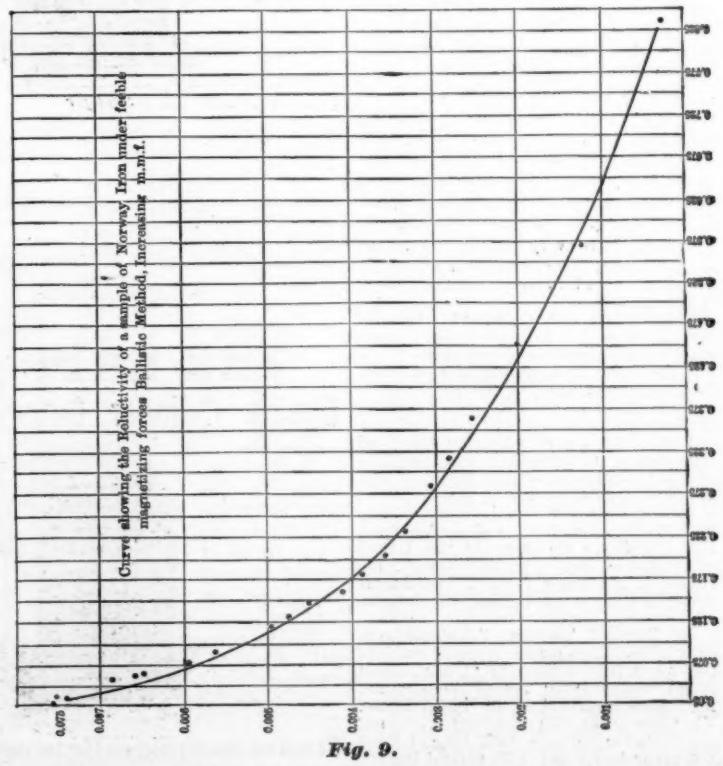

Curve allowing the Reluctivity of a sample of Norway Iron under feeble magnetising forces Ballistic Method, increasing m.m.f.

Fig. 9.

GENERAL NOTES.

The work of building a telephone line between Nebraska City and Percival, Neb., was completed last week.

Hancock, N. Y., is to have electric lights. The franchise has been granted to W. B. Morley, of Elmira.

Pontiac, Mich., was lighted by electricity from its new electric plant for the first time the night of October 26.

J. D. Hills, of Eau Claire, Wis., intends to establish an electric light plant at Menominee, with a capital stock of $30,000.

A correspondent of the Seattle, Wash., *Telegraph* complains of the miserable condition of the government sea coast telegraph line between Port Angeles and Tatoosh Island.

The report of the Hopkins-Searles will trial, amounting to from 5,000 to 17,000 words per day, was transmitted from Salem, Mass., to the San Francisco *Examiner*, with but one relay, and that at Chicago.

It has been arranged that the steamer "Westmeath" will sail from London on December 1 to bring out the new cable and lay it from Nassau to Jupiter Inlet, Fla. The work is to be completed by January 10, 1892.

An Electric Light Plant for Ohio University.

The Ohio University, at Athens, Ohio, is enlarging its incandescent plant by the addition of a new motor type direct current dynamo made by the Thomson-Houston company. The power will be furnished by a 10 horse-power automatic Racine engine. The work of installation is being done by the students in the engineering section, who will also operate the plant. Both the buildings and grounds will be lighted. In addition the students are assisting in running the city arc lighting station.

The Portland, Me., Street Railroad Company has petitioned the city of Deering for permission to lay tracks and to operate cars by electricity through Spring and Baighton streets to the line of the city of Westbrook.

KINDRED INTERESTS

The new boiler house for the Oswego Pulp and Paper Company, at Fulton, N. Y., will be of iron, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn.

The Globe Carbon Company announce their removal to a new plant at Ravenna, Ohio, where they will have a capacity of 100,000 finished carbons per day. The freight rates from Ravenna are the same as from Cleveland.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., have sent out No. 3 of their beautiful series of catalogues. This one describes the large Stanley transformers which are making such a name for themselves.

The Electric Merchandise Company report shipments of Burton electric heaters during the past week to the following places: Salem, O.; Williamsport, Pa.; Toronto, Ont., Canada; Oswego, N. Y.; Ottumwa, Ia.; Canton, O.; Akron, O.; Pottsville, Pa.; Troy, N. Y. Numerous orders received from points widely separated, testify to the general eagerness of street railway men to adopt this most desirable method of car heating.

"The Moniteur Industrielle" recommends the use of a mixture of oil and graphite on all screws in machinery. It says it will effectually prevent them from becoming fixed and protects them for years from rust, at the same time the mixture facilitates tightening up. The Joseph Dixon Crucible Company, Jersey City, N. J., have for a number of years prepared graphite mixtures which have found great favor with machinists and steam-fitters of this country. Dixon's graphite pipe joint mixture not only takes the place of red lead, but is infinitely better, while Dixon's graphited oil is used where a thinner mixture is desired and also for lubricating bearings. Graphite is the best natural lubricant known.

The Tropical American Telephone Company.

To the Editor of Electrical Review:

After 10 years' experience introducing the "Bell" telephone system and instruments in tropical territory, during which time we have been sole authorized exporters from the United States under direct assignment from the inventors, and as sole assignees (as set out in our letter heading and in a new pamphlet entitled "Telephonic Rights" of the Tropical American Telephone Company), we have learned the needs and requirements of these countries, climates and people. We have established the system in nearly every West Indian island, in nearly every large city of South America and Mexico, and in many of the Central American States.

The name of this company has been before the public and its goods before the people since 1881, and the success of the Tropical American Bell system in this entire field is sufficient proof of the quality of its instruments and apparatus and its methods of dealing with its customers. The Tropical company has changed the form and construction of its telephone sets from time to time to embody new ideas and later suggestions, until at present it is prepared to show telephone sets superior even to those used by the sub-companies of the American Bell Telephone Company in the United States, where, under a rental system, the change of old to new form of instruments would involve a change in over 500,000 sets.

The Tropical American Telephone Company's new telephone sets are sold outright for export, free of rental or royalty, and at prices less than the cost of manufacture, with royalties added, in the United States. They are made with or without platinum, non corrosive contacts, with long or short automatic hooks and with several late improvements. Descriptive circulars, with cuts and price-lists, are sent and even sample sets furnished, on application to the company. Very respectfully,

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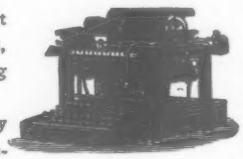

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PATENTS.

For applications filed during the remainder of 1891 my fees will be due only on allowance, if desired. Write for particulars. WM. H. BABCOCK,
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ELECTRICAL PATENTS

Index of Inventions for which Letters Patents of the United States were issued on October 20, 1891.

461,785 Trolley wire support; Leroy S. Pfouts Canton, O., assignor of one-half to William J. Piero and Fred. W. Bond, same place.
461,791 Automatic electric switch; Sigmund Bergmann, New York, N. Y., assignor to the Bergmann Manufacturing Co., same place.
461,795 Armature for electric motors or dynamos: Robert Lundell, New York, N. Y., assignor of one-half to Edward H. Johnson, same place.
461,797 Incandescent lamp filament; John T. Marshall, Metuchen, N. J., assignor to the Edison Electric Light Co., New York, N. Y.

Issued October 27.

461,808 Electric car brake; La Motte C. Atwood, St. Louis, Mo., assignor to the Atwood Electric Co., East St. Louis, Ill.
461,809 461,810 Signaling system; Frank P. Benjamin, New York, N. Y.
461,814 Electric heater; John V. Capek, New York, N. Y.
461,823 Secondary battery electrode; Justus B. Entz, New York, and William A. Phillips, Brooklyn, assignors to the Waddell-Entz Electric Co., New York, N. Y.
461,840 Trolley for electric cars; Charles A. Lieb, New York, N. Y.
461,851 System of distribution for electric railways; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.
461,858 Secondary battery; Montgomery Waddell and Justus B. Entz, New York, N. Y., assignors to the Waddell-Entz Electric Co., same place.
461,862 Electric generator; Charles G. Young, New York, N. Y.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.

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FRANK RIDLON & CO.,
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Office of the City Clerk,
Portsmouth, Ohio, October 29th, 1891.

AN APPLICATION having been made to the City Council of the said city for the establishment of a street railroad route therein, upon certain streets in said application named, notice is hereby given that proposals will be received by the undersigned on and after the twelfth day of November, 1891, for the grant of a franchise for the construction and operation of an electric street railroad in the said City of Portsmouth, Ohio.

S. G. McCOLLOCH,
City Clerk.

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